

Section 19 Flood Investigation Report

Flood and Water Management Act

Royal Borough of Greenwich

Project number: 60731992

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Quality information

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1. Introduction

1.1 Purpose of this Report

- 1.1.1 AECOM has been commissioned by the Royal Borough of Greenwich (RBG), the Client, to assess flooding experienced across the Borough from November 2023 to May 2024.
- 1.1.2 RBG, as the Lead Local Flood Authority (LLFA), has a responsibility to record and report flood incidents in accordance with Section 19 of the Flood and Water Management Act (FWMA) 2010:
1. On becoming aware of a flood in its areas, a Lead Local Flood Authority must, to the extent that it considers it necessary or appropriate, investigate -
 - a) Which Risk Management Authorities (RMAs) have relevant flood risk management functions
 - b) Whether each of those risk management authorities has exercised, or is proposing to exercise, those functions in response to the flood.
 2. Where an authority carries out an investigation under subsection (1) it must -
 - a) Publish the results of its investigation
 - b) Notify any relevant risk management authorities.
- 1.1.3 British Standards BS 85600:2017 has established criteria guidance for Section 19 post-event flood assessments, the details of which can be found in Appendix A.

1.2 Risk Management Authority Duties and Responsibilities

- 1.2.1 The legal framework for management of flood risk and events lies with several agencies; the key responsibilities of each agency are outlined in the section below.

Lead Local Flood Authority

- 1.2.2 As the LLFA, RBG have a strategic role in the management of flood risk from surface water, groundwater and Ordinary Watercourses. RBG are tasked with investigating flood incidents from these sources, where it is considered necessary and appropriate.
- 1.2.3 The FWMA states the LLFA have powers to designate structures and features that affect flooding, to safeguard assets that are relied upon for the flood risk management. Once designated, the owner must seek consent from the authority to alter, remove or replace the asset or feature (FWMA Schedule 1)¹.
- 1.2.4 RBG are also the Highway Authority with a duty to maintain adopted highways within the administrative region under Section 41 of the Highways Act 1980². This includes maintenance of road drainage networks, such as gullies.
- 1.2.5 RBG are a Category 1 Responder under the Civil Contingencies Act 2004³, therefore have a duty to develop emergency plans and assess local risks, to improve the emergency response. Information relating to civil protection matters must be made available to warn and advise the public in the event of an emergency.

¹ GOV.UK, Flood and Water Management Act 2010 Schedule 1. Available: <https://www.legislation.gov.uk/ukpga/2010/29/schedule/1> [Accessed: July 2024]

² GOV.UK, Highways Act 1980. Available: <https://www.legislation.gov.uk/ukpga/1980/66/section/41> [Accessed: July 2024]

³ GOV.UK, Civil Contingencies Act 2004. Available: http://www.legislation.gov.uk/ukpga/2004/36/pdfs/ukpga_20040036_en.pdf [Accessed: July 2024]

1.3 Environment Agency

- 1.3.1 The Environment Agency hold a strategic role and responsibility to investigate flooding from Main Rivers and the sea. Under Section 165 of the Water Resources Act (1991), the Environment Agency have permissive powers to conduct emergency or maintenance work on Main Rivers⁴.
- 1.3.2 It is important to note that flood risk from Ordinary Watercourses and surface water is not under the jurisdiction of the Environment Agency and instead, is the statutory responsibility of the LLFA. Main Rivers within RBG include the Quaggy River, Kyd Brook and Lower Kyd Brook. As there are no Main Rivers within the vicinity of any of the sites, the Environment Agency are not responsible for the investigation of the flood events within the borough.

1.4 Water and Sewage Companies

- 1.4.1 Thames Water Utilities Limited (TWUL) is responsible for the supply and drainage of water in the Royal Borough of Greenwich, including their respective surface water, foul and/or combined sewer systems. Under the Water Industry Act 1991⁵, TWUL must maintain and operate systems of public sewers, undertake capacity improvements to mitigate flood risk from sewer sources and must respond to flood incidents which involve their assets.
- 1.4.2 It is important to note TWUL does not have responsibility for highway or land drainage, until it reaches the sewer network, and does not have statutory responsibility for drainage within the property boundary and serving one property.
- 1.4.3 Sewerage systems are not designed to accommodate flows resulting from exceptionally severe weather events. Modern sewers developed by TWUL are typically designed to attenuate a flood event with an Annual Exceedance Probability (AEP), i.e. the likelihood of a flood of a specific magnitude occurring in any given year, expressed as a percentage, of 3.3%, plus allowance for climate change to comply with British Standards⁶. Larger, more intense storms would therefore be expected to result in surcharge of the sewer network.

1.5 Other Stakeholder Duties and Responsibilities

Network Rail

- 1.5.1 Network Rail operates the railway lines and associated infrastructure (signalling, bridges, embankments and tunnels) across the study area. Network Rail is an important stakeholder with regards to flood risk management, through ensuring Network Rail assets are protected from flooding, and that the operation and maintenance of railway assets and infrastructure does not increase the flood risk to neighbouring areas. Network Rail embankments, cuttings and drainage infrastructure have a significant impact on surface water drainage and flood risk in the Borough.

Transport for London

- 1.5.2 Transport for London (TfL) are an integrated transport authority responsible for the daily operation of London's transport network, including roads and public transport routes. TfL have a dedicated research function, to identify improvements which may help to reduce the impact of severe weather events on operations and asset condition. The TfL Sustainability Report indicates that considerations are being made for increases in severe weather events, including the impact of floods and subsequent damage to assets⁷.

⁴ GOV.UK, Water Resources 1991 Section 165. Available: <https://www.legislation.gov.uk/ukpga/1991/57/section/165> [Accessed: July 2024]

⁵ GOV.UK, Water Industry Act 1991. Available: <https://www.legislation.gov.uk/ukpga/1991/56/contents> [Accessed: July 2024]

⁶ Thames Water, Funding Application Guidance. AMP7 Surface Water Management Programme Revision 06. Available: <https://www.thameswater.co.uk/media-library/home/about-us/responsibility/surface-water-management-programme/swmp-funding-application-guidance.pdf> [Accessed: July 2024]

⁷ Transport for London, Sustainability Report 2021. Available: <https://content.tfl.gov.uk/tfl-sustainability-report-29-september-2021-acc.pdf> [Accessed: July 2024]

London Fire Brigade

- 1.5.3 The London Fire Brigade (LFB) are a Category 1 Responder under the Civil Contingencies Act 2004, therefore have a duty to develop emergency plans and assess local risks to inform emergency planning.

Local Residents

- 1.5.4 Residents have a responsibility to take measures to protect themselves and their property during a storm event. Residents who are aware they are at risk of flooding should take action to ensure they and their properties are protected. Residents should report flooding incidents or potential problems (such as blocked drains) to the LLFA or appropriate organisation, if known.
- 1.5.5 Riparian owners are responsible for keeping watercourses clear of debris, including clearing silt traps and reed growth.

1.6 Correspondence

- 1.6.1 Requests for Information (RFI) were sent out to a number of stakeholder organisations to inform the Flood Investigation Report. The organisations and a summary of the information received are listed in Table 1-1.

Table 1-1: Information obtained to inform the Flood Investigation Report

Date of RFI	Organisation	Role	Summary of information received
06/06/2024	Royal Borough of Greenwich	Flood Risk Manager	Description and photographs of flooding at Plumstead Road Description and photographs of flooding at Kingsground Description and photographs of flooding at White Hart Road Description and photographs of flooding at Nathan Way Plans of SuDS scheme on White Hart Road Description of flooding from Streets Services Team Asset register containing gully locations Stakeholder contact details
06/06/2024	Thames Water Utilities Limited	Technical Information Team and Area Network Manager	GIS of TWUL drainage network
06/06/2024	Environment Agency	Customer Engagement Team	Thames Tidal Downriver Breach Inundation Modelling 2018 Marsh Dykes Modelling 2020
08/08/2024	London Fire Brigade	Station Commander	Cause of flooding on Nathan Way during flood event on 13 th November 2023
08/08/2024	Transport for London	Head of Resilience Planning	No response was received therefore no impact on the report

1.7 Regional Description

- 1.7.1 RBG is located within southeast Greater London to the south of the River Thames. RBG is bordered to the west by London Borough of Lewisham, to the east by London Borough of Bexley and to the south by London Borough of Bromley. The River Thames forms the northern boundary of the borough. The Thames Barrier is a movable flood barrier in the River Thames located in RBG. Upstream of the Thames Barrier, high water levels are managed by the operation of the Thames Barrier to protect against tidal flooding. However, as the barrier is located halfway along the Greenwich Thames riverside, not all of RBG is defended by the Thames Barrier.
- 1.7.2 RBG is densely populated and data from the 2021 census recorded it has a population of 289,100⁸. Areas including Woolwich, Thamesmead, Charlton, also the areas adjacent to the Deptford Creek and the area between Kidbrooke and Eltham are considered as being densely populated. Areas of open

⁸ Office for National Statistics, 2023, How life has changed in Greenwich: Census 2021
<https://www.ons.gov.uk/visualisations/censusareachanges/E09000011> [Accessed August 2024]

space are located in Greenwich Park, Shooters Hill, Avery Hill Park and Royal Blackheath Golf Club, Charlton Park, Eltham Common, Bostal Woods and Eltham Park South.

1.7.3 The northern part of RBG is characterised by the tidal River Thames. According to the Level 1 Strategic Flood Risk Assessment⁹, the following principal watercourses are also present within the borough:

- The Quaggy River is a tributary of the River Ravensbourne, draining the south western section of the borough, and the floodplain of the Ravensbourne extends to impact areas within RBG. As the River Ravensbourne nears its confluence with the River Thames it becomes tidally influenced and flows through the far north west of the borough as the Deptford Creek
- The Quaggy River is a tributary of the River Ravensbourne; it rises from Locksbottom in London Borough of Bromley, flows through Bromley and enters the southwestern side of RBG at Sidcup Road. It flows north through Eltham and then west through Sutcliff Park and out of the RB of Greenwich to its confluence with River Ravensbourne near Lewisham station
- The Kyd Brook is a tributary of the Quaggy; it rises in Kidbrooke and flows south west through Blackheath Park to Lee Road, where it flows south along the boundary of RBG and joins the River Quaggy by Meadowcourt Road before flowing into the London Borough of Lewisham
- The River Shuttle rises in Avery Hill Park in the south eastern part of RBG and flows eastwards to join the River Cray just to the south of Hall Place and the A2 East Rochester Way in neighbouring London Borough of Bexley
- The Wickham Valley Watercourse rises in Oxleas Wood and flows north before entering a culvert and flowing into the Butts Canal. The Butts Canal is culverted along much of its length from the playing fields adjacent to Woodbrook Road to its outfall into South Mere (outside of the borough boundary) in the Thamesmead area. This forms part of the wider Marsh Dykes surface water management system which was put in place in the 1960s when a large area of land was reclaimed from the marshland for commercial and residential development.

Affected Sites

1.7.4 Four affected sites were identified by RBG as being affected by flood events from November 2023 to May 2024 and have been taken forward for the purposes of this Section 19 Flood Investigation; they are highlighted in Figure 1-1 and are as follows:

1. **Kingsground, Middle Park (south of the borough)**, including areas around King John's Walk
2. **Nathan Way, Plumstead (east of the borough)**, including areas around Magpie Lane, Ridgeway and White Hart Road
3. **Plumstead Road, Plumstead (east of the borough)**
4. **Plumstead High Street, Plumstead (east of the borough).**

⁹ AECOM, 2017, Royal Borough of Greenwich Level 1 Strategic Flood Risk Assessment

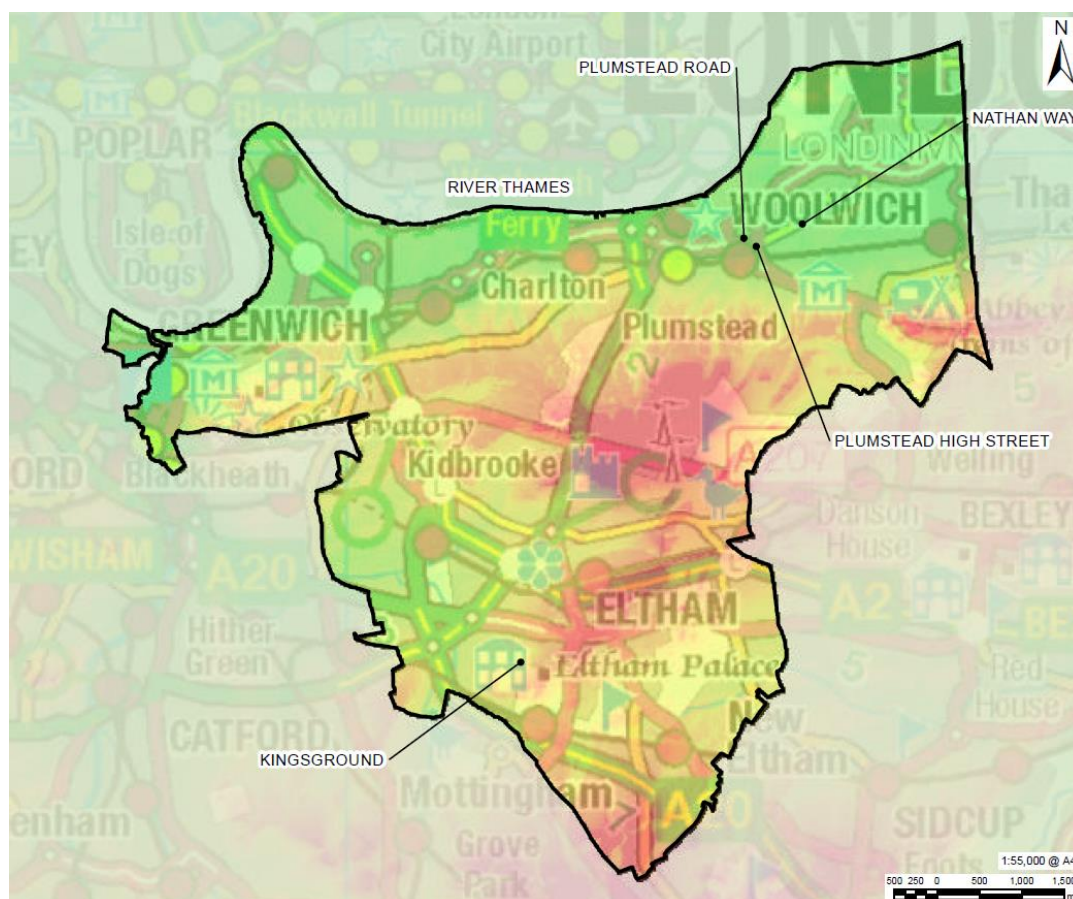


Figure 1-1: Location of affected sites within Royal Borough of Greenwich boundary

1.8 Meteorological Conditions

Overview

1.8.1 A number of localised flooding incidents have occurred at locations across RBG over the period between November 2023 and May 2024. Over this period, the flooding incidents listed below have been recorded:

- 19th-20th January 2024 - External flooding affecting the gardens of three residential properties and the highway at Kingsground
- 12th December 2023 - Flooding of the highway at the entrance to the Greenwich Reuse and Recycling Centre and the highway at the junction between Ridgway and Nathan Way
- 28th April 2024 and 6th May 2024 - Flooding of the cycle lane on Plumstead Road
- 13th November 2023 and 12th December 2023 - Flooding of the highway between the junction of White Hart Road and North Road and the railway underpass.

Antecedent Conditions

1.8.2 The Environment Agency Monthly Water Situation Reports for December 2023¹⁰ and January 2024¹¹ indicate that the three-month cumulative rainfall totals at the end of December 2023 and at the end of January 2024 were classed as 'notably high' and 'above normal' respectively in South East London. As presented in Figure 1-2 the monthly rainfall totals in South East England for the months of October, November, and December in 2023 equated to 140-210% of the long term average for these months,

¹⁰ National Monthly Water Situation Report December 2023: https://assets.publishing.service.gov.uk/media/659ecedfe8f5ec000d1f8b4e/Water_situation_report_for_England_December_2023.pdf [Accessed September 2024].

¹¹ National Monthly Water Situation Report January 2024: https://assets.publishing.service.gov.uk/media/65ca15c2cc433b0011a90bfb/Water_situation_report_for_England_January_2024.pdf [Accessed September 2024].

whilst the monthly rainfall total in January 2024 for the region was marginally above 100% (or normal) of the long term average for this month.

- 1.8.3 The Environment Agency Monthly Water Situation Report for May 2024¹² indicates that the three-month cumulative rainfall total at the end of May 2024 was 'notably high' in South East London. As presented in Figure 1-2 the monthly rainfall totals in South East England for the months of March, April, and May equated to 120-160% of the long-term average for South East England.

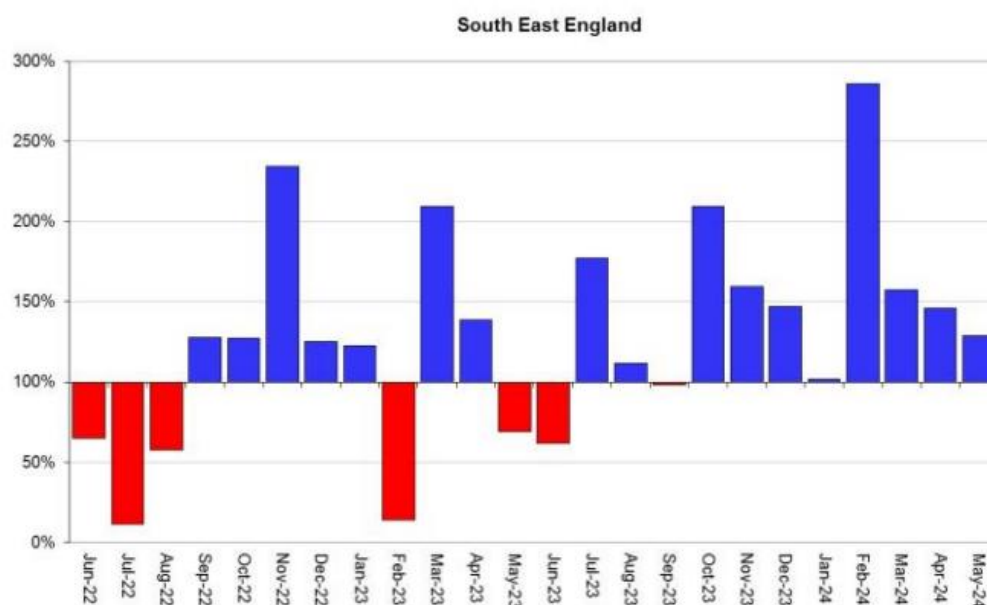


Figure 1-2: Monthly rainfall totals for the past 24 months as a percentage of the 1961 to 1990 long term average for South East England (extracted from Environment Agency Monthly Water Situation Report May 2024¹²)

- 1.8.4 As presented in Figure 1-3, the Soil Moisture Deficit (SMD) values in South East England were approximately 20mm-40mm lower in the period November 2023 to January 2024 relative to the long term average for the period 1961-1990 for these months in this region. Additionally, the soils throughout the period November 2023 to January 2024 were at, or within 10mm of field capacity. Field Capacity refers to the maximum amount of water that the soil can hold after all excess water has drained away via gravity, whilst the SMD is the amount of rainwater required to return the soil to field capacity.

¹² National Monthly Water Situation Report May 2024:
https://assets.publishing.service.gov.uk/media/66685d1b6c5954022e760d72/Water_situation_report_for_England_May_2024.pdf [Accessed September 2024].

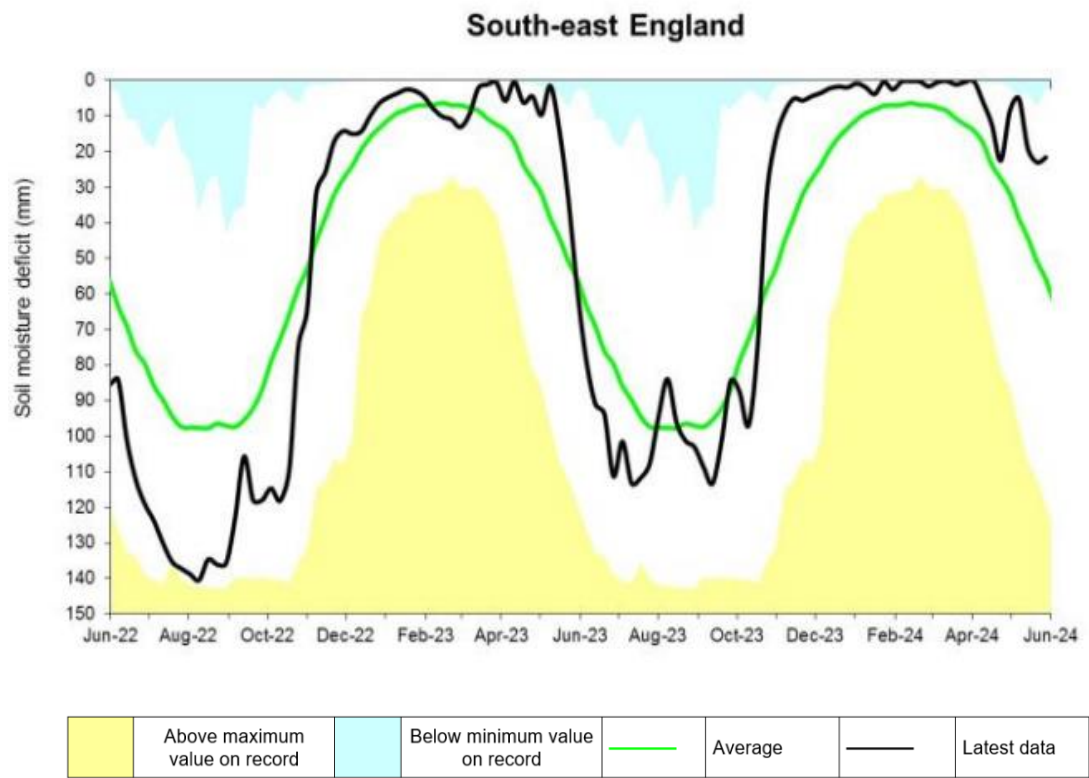


Figure 1-3: Soil Moisture Deficit for South East England compared to the 1961-1990 long term average at the end of May 2024 (extracted from Environment Agency Monthly Water Situation Report May 2024¹²)

Rain Gauge Data

- 1.8.5
- Observed rainfall data (15-minute time interval) has been downloaded from the Hydrology Data Explorer¹³ for the relevant time periods at the three closest rainfall gauges to the affected sites. The names and locations of the three rainfall gauges are presented in Figure 1-4.

¹³ Hydrology Data Explorer (accessed August 2024): <https://environment.data.gov.uk/hydrology/explore>

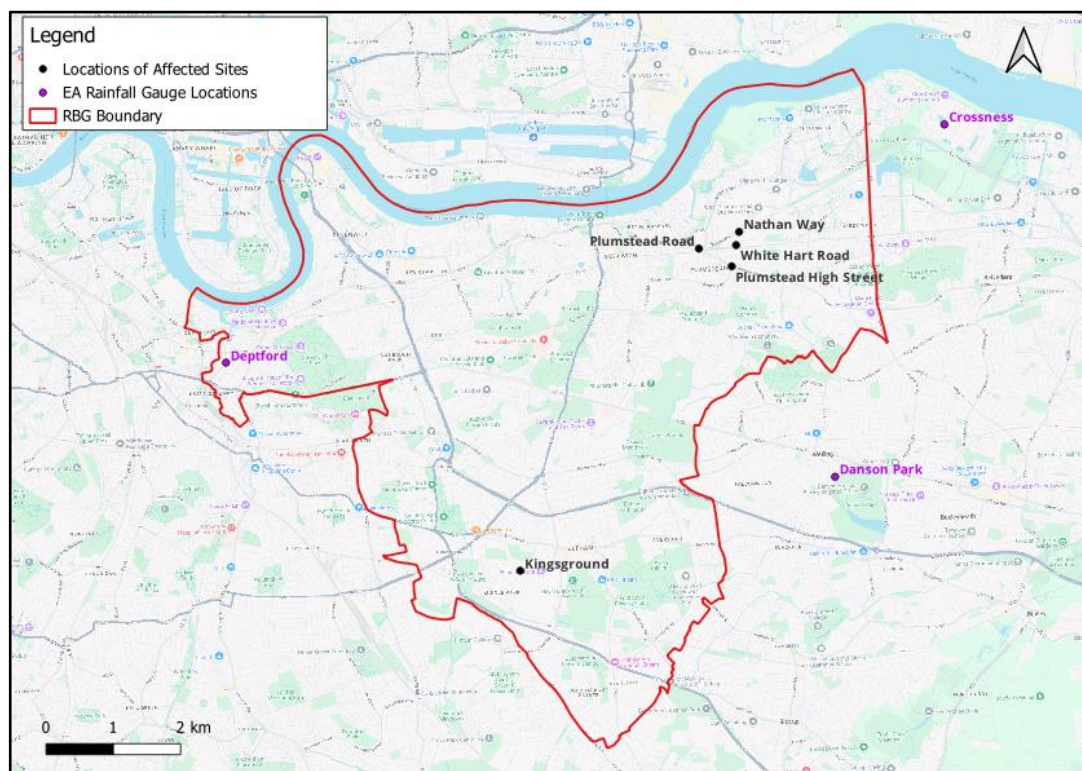


Figure 1-4: Locations of affected sites and local rainfall gauges. © Environment Agency copyright and/or database right 2015. All rights reserved. Map data ©2024 Google.

- 1.8.6 The rainfall depth and duration recorded on the dates of 13th November 2023, 12th December 2023, 21st-22nd January 2024, 28th April 2024 and 6th May 2024 at the three rainfall gauges are presented in Table 1-2, Table 1-3, Table 1-4, Table 1-5, and Table 1-6 respectively. Outputs from the Flood Estimation Handbook (FEH) 22 Depth-Duration-Frequency Model¹⁴ were obtained at the locations of the three rainfall gauges from the FEH Web Service¹⁵ to provide indicative AEPs for the observed rainfall depths and durations.
- 1.8.7 The rain gauge data shows that there is a high degree of spatial uniformity in rainfall depth and duration across the borough for the rainfall events on 13th November 2023, 12th December 2023, and 21st-22nd January 2024, which is indicative of the widespread rainfall associated with frontal systems. Conversely, observed rainfall on 28th April 2024 and 6th May 2024 was confined to Danson Park gauge, which may be suggestive of the rainfall on this date being associated with a localised thunderstorm.
- 1.8.8 Table 1-3 provides two values for both Rainfall Depth and Event Duration as two distinct rainfall events were recorded on 12th December 2023, with a four hour period between events.

Table 1-2: Rain Gauge data for 13th November 2023

Rain Gauge Name	Rainfall Depth (mm)	Event Duration (hrs)	Annual Exceedance Probability (%)	Data Quality Flag
Deptford	14.20	3.25	<100	Good
Danson Park	15.52	5	<100	Good
Crossness	12.80	3.25	74	Good

Table 1-3: Rain Gauge data for 12th December 2023

Rain Gauge Name	Rainfall Depth (mm)	Event Duration (hrs)	Annual Exceedance Probability (%)	Data Quality Flag
Deptford	10.00 and 3.60	1.5 and 0.75	<100	Good

¹⁴ Centre for Ecology and Hydrology, The FEH22 rainfall depth-duration-frequency (DDF) model:

[https://fehwebdocs.hydrosciences.co.uk/attachments/The%20FEH22%20rainfall%20depth-duration-frequency%20\(DDF\)%20model-caa11347-4ff7-4c89-b707-bf5bb1c05d79.pdf](https://fehwebdocs.hydrosciences.co.uk/attachments/The%20FEH22%20rainfall%20depth-duration-frequency%20(DDF)%20model-caa11347-4ff7-4c89-b707-bf5bb1c05d79.pdf)

¹⁵ UK Centre for Ecology and Hydrology, FEH Web Service: <https://fehweb.ceh.ac.uk/Map>

Danson Park	3.38 and 5.47	0.5 and 1.5	<100	Good
Crossness	8.8 and 5.00	2.25 and 0.75	<100	Good

Table 1-4: Rain Gauge data for 21st-22nd January 2024

Rain Gauge Name	Rainfall Depth (mm)	Event Duration (hrs)	Annual Exceedance Probability (%)	Data Quality Flag
Deptford	3.04	2	<100	Good
Danson Park	2.80	3.25	<100	Good
Crossness	3.0	2.5	<100	Good

Table 1-5: Rain Gauge data for 28th April 2024

Rain Gauge Name	Rainfall Depth (mm)	Event Duration (hrs)	Annual Exceedance Probability (%)	Data Quality Flag
Deptford	Not available	Not available	Not available	Not available
Danson Park	26.55	17.5	74	Unchecked
Crossness	0.00	0	0	Good

Table 1-6: Rain Gauge data for 6th May 2024

Rain Gauge Name	Rainfall Depth (mm)	Event Duration (hrs)	Annual Exceedance Probability (%)	Data Quality Flag
Deptford	Not available	Not available	Not available	Not available
Danson Park	7.63	7.25	<100	Unchecked
Crossness	0.00	0	0	Unchecked

Summary

- 1.8.9 The Environment Agency Monthly Water Situation Reports^{10,11, 12} show that the three-month cumulative rainfall totals at the end of December 2023 and at the end of January 2024 were classified as 'notably high' and 'above normal' in south east London, as reflected in the SMD values which were within 10mm of field capacity throughout the period November 2023 to January 2024. Such high soil saturation levels would reduce the infiltration capacity and generate greater surface water runoff in local catchments. Likewise, the three-month cumulative rainfall total in South East London was classed as being 'notably high', with accompanying SMD values in May 2024 in South East England being approximately 10-30mm higher than field capacity.
- 1.8.10 The rainfall events on 13th November 2023 and 12th December 2023 affecting White Hart Road and Nathan Way had an AEP of 100% i.e. a rainfall event with a magnitude expected to occur once each year, at the Crossness and Deptford rainfall gauges, and an AEP of 74% at the Danson Park rainfall gauge. Likewise, the rainfall events on 28th April 2024 and 6th May 2024 that affected Plumstead Road had AEPs of 74% and less than 100% AEP, i.e. more frequent than once a year, at Danson Park rainfall gauge.
- 1.8.11 As the above results do not indicate that significantly high rainfall events were experienced during the dates investigated, it would indicate that there was an additional causative factor for the flooding such as drainage system blockage.
- 1.8.12 The 15 minute rainfall data downloaded for the rainfall gauges at Danson Park and Deptford shows that the only rainfall event recorded during the period 19th-21st January 2023 was on the night of 21st/22nd January 2023. Therefore, it is likely that the records of flooding on 19th and 20th January 2023 at Kingsground are incorrect, with flooding at this location likely to have occurred on 21st January and 22nd January 2023. It is assumed that the surface water drainage and infiltration capacity at this location was exceeded by the rainfall event on 21st-22nd January 2023 resulting in external flooding of the residential properties.

2. Flooding Impacts and Mechanisms

2.1 Overview

- 2.1.1 The following section summarises the flood impacts and mechanisms investigated for each of the sites which were identified as being affected by a flood event between November 2023 and May 2024. For each site, an overview of the environment and topography is provided, in addition to an assessment of flooding mechanisms and impacts. This has formed the basis for recommendations, which are presented throughout the report.
- 2.1.2 The location of affected sites and other relevant information gathered during the consultation process, was reviewed to determine the potential flooding mechanisms and to identify areas which may benefit from a site walkover in accordance with the project brief. The site visits were undertaken on the 15th and 16th July 2024 by two AECOM representatives and one RBG representative. The scope, extent and timing of the site visit was agreed with RBG prior to undertaking work on site. The objective of the site visit was to:
- Identify and appraise historic flooding mechanisms, including source pathway, receptor
 - Engage with local residents and relevant stakeholders, to capture anecdotal evidence of the flood events.
- 2.1.3 The following sites, shown in Drawing B1 and B2 in Appendix B, were visited during the walkover, as part of the agreed scope:
- Kingsground, Middle Park**, including areas around King John's Walk
 - Nathan Way, Plumstead**, including areas around Magpie Lane, Ridgeway and White Hart Road
 - Plumstead Road**
 - Plumstead High Street**
- 2.1.4 Contact was made with local residents and businesses affected by the flooding by knocking on doors. Where contact was not made, a letter was delivered to the property/business encouraging them to share their knowledge of the flood event and condition of the local environment with RBG via email.
- 2.1.5 A member of the Street Services Team was present on the second day of the site visit to provide further insight into the areas affected, response to the flood events and maintenance of each area.
- 2.1.6 The following sections describe each of the affected sites in detail and provide site observations, flooding mechanisms and recommendations.

2.2 Kingsground

Site Location

- 2.2.1 Kingsground is located in the south of the borough in Middle Park, to the south west of Eltham. Kingsground is located within a residential area with a small number of community buildings. The area is surrounded by a number of green spaces including the Civil Service Sports Ground, Middle Park Field, Queenscroft Recreation Ground and King John Playing Fields. The Quaggy River lies approximately 700 metres to the west. The area is connected through a series of local roads maintained by RBG and public footpaths. To the east of Kingsground lies Eltham Palace and Eltham Palace Stables.
- 2.2.2 Key sites of interest within, and in vicinity to, Kingsground are presented in Drawing B3 and Drawing B4, Appendix B.

Topography

- 2.2.3 Light Detecting and Ranging Data¹⁶ (LiDAR) was downloaded from the Government's Data Services Platform at a 1m resolution. The land slopes westwards with the residential area of Middle Park lower

¹⁶ Environment Agency, National Light Detecting and Ranging Data (LiDAR) Programme <https://www.data.gov.uk/dataset/f0db0249-f17b-4036-9e65-309148c97ce4/national-lidar-programme#licence-info> [Accessed 10 July 2024]

than the land to the east. The junction of King John's Walk and Court Yard lies at approximately 59.8 metres Above Ordnance Datum (m AOD). There is also a high spot in the fields to the south of King John's Walk with a level of approximately 58.6 m AOD. The land slopes towards King John's Walk, at the junction with the public footpath, the land lies at approximately 49.3 m AOD and at Eltham Palace Stables the land lies at approximately 52.5 m AOD. The land slopes towards Kingsground with an approximate level of 38.6 m AOD where the surface water flooding was reported on the highway. At the lowest point on Kingsground at the junction with The Vista, the land lies at approximately 37.8 m AOD. The properties to the west of the road lie around 1 m lower than the road level. The LiDAR data of the site is shown in Drawing B4, Appendix B.

Geology

- 2.2.4 The British Geological Survey¹⁷ (BGS) website identifies the bedrock underlying the site as Lambeth Group (sand, silt and clay). The site is not overlain by superficial deposits.
- 2.2.5 The Groundwater Aquifer Designation Map¹⁸ indicates the bedrock is a Secondary A Aquifer. This is defined by the BGS as a *"permeable layer capable of supporting water supplies at a local rather than strategic scale and in some cases forming an important source of base flow to rivers"*. The remainder of the borough to the east is designated unproductive strata which is defined as *"rock strata with low permeability that has negligible significance for water supply or river base flow"*.

Assessing Flood Risk

- 2.2.6 The Environment Agency's Flood Map for Planning¹⁹ shows that Kingsground is located within Flood Zone 1, land that is assessed as having less than a 0.1% AEP of flooding from rivers or the sea. The flood plain associated with the Quaggy River to the west of Kingsground is located within Flood Zones 2 and 3, land that has been assessed as having between a 1% and 0.1% AEP of flooding from rivers and land that has been assessed as having a greater than 1% AEP of flooding from rivers.
- 2.2.7 The Environment Agency's Long Term Flood Risk Map²⁰ shows areas affected by surface water flooding. Surface water flooding is classified into four flood risk categories: Very Low (less than 0.1% AEP), Low (between 0.1% and 1% AEP), Medium (between 1% and 3.3% AEP) and High (greater than 3.3% AEP).
- 2.2.8 The mapping shows a significant flow path from Eltham Palace along King John's Walk and the public footpath, westwards towards Kingsground. The flow path crosses the highway where the risk of flooding is High and continues in a westerly direction flowing towards the Quaggy River. There are a number of other surface water hotspots which are predominantly linked with the road network including Queenscroft Road, The Vista, Middle Park Avenue and Churchbury Road.
- 2.2.9 In accordance with the Environment Agency's Long Term Flood Risk Map, Kingsground is not located in an area at residual risk of failure or breach of a reservoir.

Assets

- 2.2.10 It is understood that Kingsground is underlain by a combined sewer network, which conveys foul and surface water flows and that there are a combination of RBG and TWUL gullies and drainage networks at the site as shown in Drawing B3, Appendix B.
- 2.2.11 RBG provided a register of road gullies and TWUL provided a dataset of their drainage system which includes information on cover levels and invert levels. It should be noted that this information is not available for all manholes.
- 2.2.12 There are two TWUL manholes outside of properties 201 and 203 Kingsground, both with cover levels of 38.5 m AOD and another two on the junction with Eltham Palace Road, both with cover levels of 38.3 m AOD. There are a number of road gullies, owned by RBG along Kingsground.

¹⁷ BGS Geology Viewer. BGS website. <https://geologyviewer.bgs.ac.uk/>. [Accessed August 2024]

¹⁸ BGS Aquifer Maps available via Defra Magic Map <http://magic.defra.gov.uk/MagicMap.aspx>. [Accessed August 2024]

¹⁹ Environment Agency, Flood Map for Planning <https://flood-map-for-planning.service.gov.uk/> [Accessed August 2024]

²⁰ Environment Agency, Check your long term flood risk <https://check-long-term-flood-risk.service.gov.uk/map> [Accessed August 2024]

- 2.2.13 The Environment Agency AIMS Spatial Flood Defences (inc. standardised attributes) dataset shows that there are no Environment Agency assets at Kingsground. The closest assets are natural high ground to the west and the south along the Quaggy River. There is a raised bund behind the properties on Kingsground, approximately from 167 Kingsground to 187 Kingsground. This bund is not owned by TWUL or RBG and is not a registered flood risk asset, however it is acting as a flood defence mechanism and allows water to pond in the paddock to the east of the properties.

Hydrology

- 2.2.14 See Section 0 for details of the hydrology and rainfall events local to the site.

Flood History

- 2.2.15 Resident's records indicate that flooding occurred at Kingsground in March 2023, January 2024 during Storm Isha from the 21st – 24th, February 2024 and March 2024. External flooding was reported in the rear gardens of each of the properties, the alleyways adjacent to the properties and the front gardens. Residents confirmed the water did not enter any property.
- 2.2.16 The information presented in Table 2-1 has been collected from residents and RGB however may not be exhaustive.

Table 2-1. Flood History provided by resident.

Date	
March 2023	Significant flooding. Prolonged rainfall created ponding in the paddock to the rear of the properties, as shown in Photograph 3, which eventually overtopped into the back gardens on Kingsground. The gardens of 175 and 177 were almost completely submerged.
January 2024 during Storm Isha (19 – 21 January)	Significant flooding. Prolonged rainfall created ponding in the paddock which eventually overtopped into the back gardens of the properties on Kingsground. The gardens of 175 and 177 were almost completely submerged. Water came up to the back door of 177 and was 'a couple of inches' below the threshold level of the property. The water reportedly cascaded down the alleyway between the houses and submerged the front driveway and garden of both 175 and 177 as shown in Photograph 1 .
February 2024	A large pond appeared in the paddock at least twice in February 2024 but did not overtop into the rear gardens of the properties. Each time there is rain for 2-3 days it is reported that the paddock becomes saturated and a pond begins to form.
March 2024	Minor flooding in garden of 175 as shown in Photograph 2.



Photograph 1: Front garden of 177 Kingsground



Photograph 2: Rear garden of 179 and 177 Kingsground and ponding visible beyond boundary of garden



Photograph 3: Pond formed following rainfall in the paddock to the east of Kingsground properties

Site Observations

Kingsground

- 2.2.17 Kingsground road is residential highway owned by RGB which runs from Eltham Hill in the north to Middle Park Avenue to the south. The road slopes down from Eltham Hill (the A210) to the north, to a low spot north of the junction with The Vista. See Drawing B4, Appendix B.
- 2.2.18 A public footpath between properties 163 and 165 leads from Kingsground to King John's Walk. There is also an alleyway between 173 and 175 visible in Photograph 4. Behind the properties to the east lies a horse paddock which slopes upwards towards Eltham Palace Stables as shown in Photograph 5.
- 2.2.19 Through conversations with residents during the site visit, two property owners confirmed they were affected by external flooding to their gardens during Storm Isha (21st - 24th January 2024). One resident reported that during periods of heavy rain, a pond appears at the base of the slope in the paddock to the east of the properties on Kingsground. A low spot is visible behind these properties on LIDAR as shown in Drawing B4, Appendix B. A raised bund is situated to the east of the rear gardens of the properties which acts as a flood defence mechanism and allows water to pond behind the properties in the paddock. During the flood events, the water level in the pond rose, before flowing into

the rear gardens of the properties with one resident's property reported as having water up to the back doorstep.

- 2.2.20 Water reportedly flowed down the alleyway between properties 173 and 175, into the front garden and onto the highway. Photograph 1 shows flood water at the front of the property flowing on to the highway. It was reported locally that once the water reached the highway, it ponded for a while before draining away, therefore blocked highway drains is not thought to be a contributing factor here.
- 2.2.21 During the site visit, it was noted that the properties on the western side of Kingsground are below the level of the highway as shown in Drawing B4, Appendix B. It was observed that if the level of flooding on the road breaches the kerb height, these properties could be at risk of flooding internally.



Photograph 4: Alleyway between 173 and 175 **Photograph 5: Horse paddock to the east of Kingsground.**

King John's Walk

- 2.2.22 King John's Walk is a private road that runs parallel to Kingsground, to the east of the horse paddock. The road is a narrow single lane road and slopes downwards from Eltham Palace towards Kingsground. At the paddock, the road turns left and narrows again as it leads towards the Eltham Palace Stables. Along this section of King John's Walk a drainage channel is located along the field edge of the road which discharges into gullies at the junction of King John's Walk and the public footpath. At the junction with the footpath, three gullies are present (Photograph 6). The drainage channel is heavily silted in places with evidence that water flows out of the drainage channel and into the paddock rather than flowing into the surface water drainage system.
- 2.2.23 RBG commissioned 1st About Plumbing and Carpentry to undertake a survey of the site's surface water drainage system in February 2024. The survey reported concerns about surface water flow along the public footpath from King John's Walk towards Kingsground. The report also highlighted the possibility of overflow from Eltham Palace Moat in conjunction with surface water from Court Yard, however this claim has not been confirmed. They surmised that there was insufficient drainage installed along King John's Walk and that the current surface water drainage is not sufficiently maintained.
- 2.2.24 Following the above survey, RBG's Street Services team visited the site in early March 2024 and undertook gully clearing. They reported the drains on Court Yard were all unblocked and running free and cleared the gullies on the junction between King John's Walk and the public footpath. The Streets Services team did report that they were unable to access the section of King John's Walk leading up to Eltham Palace Stables as the vehicle was too large.



Photograph 6: Three gullies at the junction between King John's Walk and the public footpath



Photograph 7: Silted drainage channel along King John's Walk

Eltham Palace Stables

- 2.2.25 Eltham Palace Stables are located on King John's Walk and are situated in the Eltham Palace Conservation Area (see Drawing B3, Appendix B). To the west of the stables are the two grazing fields/paddocks which slope down towards the rear gardens of the properties on Kingsground.
- 2.2.26 There are visible signs of runoff from Eltham Place Stables, as seen in Photograph 8 and Photograph 9. This is understood to be due to ongoing activities within the stables as there had not been a significant period of rainfall prior to the site visit.



Photograph 8: Surface water drainage from Eltham Palace Stables onto King John's Walk



Photograph 9: Entrance to Eltham Palace Stables from King John's Walk

Eltham Palace

- 2.2.27 Eltham Palace is located at the junction between Court Yard and King John's Walk. A moat surrounds the palace on the eastern and northern sides. RBG received reports that the palace has experienced basement flooding in the past, however no evidence of this was available at the time of this investigation.

Flooding Mechanisms

- 2.2.28 Following a review of the data, stakeholder consultation and site walkover it is concluded that the flooding at Kingsground was a result of the following:
- Following periods of rainfall, the paddock to the east of Kingsground become saturated and surface water ponded at the base of the hill. The steep topography of the paddock to the east increased the velocity and conveyance of surface water to the lower elevation. This water accumulated in the field behind the properties before flowing into the gardens and through the alleyway between 173 and 175 Kingsground onto the highway
 - The drainage channel along King John's Walk should direct surface water into the gullies and highway drainage system at the junction of King John's Walk and the public footpath. This drainage channel is heavily silted and therefore surface water is not channelled into the gullies and instead flows into the paddock
 - A review of roadside gullies on King John's Walk during the site visit identified the gullies were blocked with debris, reducing the effectiveness of drainage.

Recommendations

- 2.2.29 Through the assessment of flood mechanisms, several recommendations for improvement have been identified:
- RBG should ensure routine highway drainage gully cleaning, whilst TWUL should undertake routine monitoring of sewer networks
 - RBG should investigate a solution for reducing surface water runoff across the paddock and ensuring surface water is able to enter the drainage network on King John's Walk. Possible solutions include constructing a kerb along the edge of the King John's Walk to direct flow into the surface water drainage network and prevent flow passing onto the paddock.

2.3 Nathan Way

Site Location

- 2.3.1 Nathan Way is located in the north-east of the borough approximately 1 kilometre (km) south-east of the River Thames in Plumstead, as shown in Drawing B1 and B2, Appendix B. Nathan Way links Western Way to Eastern Way and is in a predominately industrial area which includes the West Thamesmead Business Park. The Ridgeway path runs for three and a half miles across south London from Plumstead Station to Crossness Pumping Station. The path runs parallel to the south of Nathan Way and is a footpath owned by TWUL²¹. The Ridgeway is built on an embankment which covers the Southern Outfall Sewer. A footpath links Nathan Way over the Ridgeway onto White Hart Road which extends southwards for approximately 450 m, passing under the railway line and continuing to join Plumstead High Street. Towards the eastern end of Nathan Way lies a turning into Magpie Lane where the Greenwich Reuse and Recycling Centre is located.
- 2.3.2 The Wogebourne River lies approximate 550 m to the southeast of Nathan Way. The lower reaches in Plumstead, Abbey Wood, and Thamesmead are mostly within culverts beneath residential areas. Crossness Pumping Station is located approximately 2 km's northeast of Nathan Way, adjacent to the River Thames.
- 2.3.3 Key sites of interest within, and in vicinity to, Nathan Way are presented in Drawing B5, Appendix B.

Topography

- 2.3.4 LiDAR¹⁶ data shows Nathan Way sits at a lower elevation compared to the land to the north of the site. There are a number of low points along the highway on Nathan Way. This includes between the junction of Hadden Road and Ridgeway and outside of the car garage (Unit 1, 71-73 Nathan Way) which lies at approximately 0.73 – 1 m AOD. Another low point is outside 129-131 Nathan Way and 141-143 Nathan Way with the lowest point approximately 0.75 m AOD. There is also a low point along

²¹ Thames Water, 2018, Collaborative working to reduce disruption, <https://www.thameswater.co.uk/media-library/home/about-us/responsibility/sustainability/corporate-responsibility-sustainability-case-study-2017-18.pdf>

the length of Magpie Lane with a low of 0.83 m AOD. The Ridgeway raised embankment lies at 6 – 7 m AOD. To the south of the Ridgeway, in the Abbeywood area, the land lies low between approximately 0.3 and 1 m AOD. There is a raised area of land to the south of the embankment at White Hart Avenue which lies at approximately 6.7 m AOD. This land slopes south-westwards towards White Hart Road.

2.3.5 White Hart Road slopes southwards from a level of approximately 1.1 m AOD at the Ridgeway to its lowest point under the railway line at approximately 0 m AOD. The road then rises towards Plumstead High Street the south to a level of 8.9 m AOD.

2.3.6 The LiDAR data of the site is shown in Drawing B7, Appendix B.

Geology

2.3.7 The BGS¹⁷ website identifies the bedrock underlying the site as Thanet Formation of the Thanetian Age. The Thanet Formation is typically composed of homogenous silty fine-grained sand with sandy silt, silt or sandy, silty clay especially in the lower part, forming a coarsening-upwards sequence. The bedrock is overlain of superficial deposits of Alluvium (clay, silt, sand and peat) in the majority of the area with an outcrop of Head deposits (clay, silt, sand and gravel) to the south of the railway line at White Hart Road.

2.3.8 The Groundwater Aquifer Designation Map¹⁸ indicates the bedrock is a Secondary A Aquifer and the Superficial as a Secondary (undifferentiated) Aquifer. According to BGS definitions, a Secondary (undifferentiated) aquifer is defined as an “*aquifer where it is not possible to apply either a Secondary A or B definition because of the variable characteristics of the rock type. These have only a minor value*”.

Assessing Flood Risk

2.3.9 The Environment Agency's Flood Map for Planning¹⁹ shows that the whole of Nathan Way, including Magpie Lane, is located within Flood Zone 3, land that has been assessed as having a greater than 1% AEP of flooding from rivers or with a 0.5% AEP or greater chance of flooding each year from the Sea. The majority of White Hart Road is also located within Flood Zone 3 with only the section of road between Plumstead High Street and Hartville Road being Flood Zone 1.

2.3.10 The Environment Agency's Long Term Flood Risk Map²⁰ shows areas affected by surface water flooding. The mapping shows a High risk (greater than 3.3% AEP) of surface water flooding along Nathan Way with ponding on the highway along Magpie Lane, outside the One Stop Auto Repair Centre, between Hadden Road and Ridgeway and to the west of Hadden Road. The majority of White Hart Road is also shown to be at high risk of surface water flooding, except for a small section of the highway north of Hartville Road which is at Medium risk.

2.3.11 In accordance with the Environment Agency's Long Term Flood Risk Map, Nathan Way is located in an area at residual risk of failure or breach of a reservoir when there is also flooding from rivers. White Hart Road however is not at risk.

Assets

2.3.12 It is understood that Nathan Way is underlain by a combined sewer network, which conveys foul and surface water flows and that there are a combination of RBG gullies and TWUL drainage network at the site, as shown in Drawing B6, Appendix B.

2.3.13 There are a number of TWUL manholes along Nathan Way. The cover levels of the manholes on Nathan Way vary between 0.82 and 2.9 m AOD with the lowest points being at the Hadden Road junction (0.82 m AOD), Ridgeway junction (0.85 m AOD), outside the One Stop Auto Repair Shop (0.82 m AOD), outside Priorclave (0.88 m AOD) and outside S2 Events (0.84 m AOD).

2.3.14 There is also a network of TWUL manholes on White Hart Road with one located where the road passes underneath the railway line. No cover level information is available for these manholes.

2.3.15 The Environment Agency AIMS Spatial Flood Defences (inc. standardised attributes) dataset shows that there are no Environment Agency assets at Nathan Way. The closest assets are an open channel and natural high ground to the north at Gallion's Park and to the west at Birchmere.

Hydrology

- 2.3.16 See Section 0 for details of the hydrology and rainfall events local to the site.

Flood History

- 2.3.17 Information provided by RGB LLFA and Street Services Team indicate that flooding occurred at Magpie Lane (Greenwich Reuse and Recycle Centre) on 12th December 2023. This was reported to be external flooding only. Flooding was also reported at the junction with Ridgeway around the same time as the flooding elsewhere on Nathan Way and approached the frontage of some commercial properties but not internally. Flooding on White Hart Road was reported on 13th November 2023. Video footage was provided which shows the underpass and the area to the north of the railway line underwater with evidence of a surcharging manhole. This information may not be exhaustive and is collected from the information available from RGB.
- 2.3.18 A news article by ITV²² reported flooding on Nathan Way on 12th December 2023, with firefighters attending the scene and a road closure being put in place, although the exact location of this is unknown. Correspondence from the London Fire Brigade indicated this flooding was due to a burst water main.

Site Observations

Nathan Way - Ridgeway

- 2.3.19 Nathan Way is a C classed road owned by RGB. The site visit at this location was conducted with a member of RGB LLFA and a member of the Streets Services Team.
- 2.3.20 There is an obvious low point on Nathan Way opposite the footpath entrance to the Ridgeway as shown in Photograph 10.
- 2.3.21 It is understood that Nathan Way drains to a combined sewer network, which drains to the Crossness pumping station. There are two TWUL manholes on Nathan Way opposite the Ridgeway, one with a cover level of 0.85. Anecdotal evidence from Street Services Team reported that when Crossness Pumping Station is not allowed to discharge, this backs up the drainage network along Nathan Way and causes surcharging at the manholes. As this is one of the lower manholes on the road, surcharges occur in this location.

²² ITV, Dec 2023, Drivers abandon cars in rising floodwater in South London. <https://www.itv.com/news/london/2023-12-13/floods-leave-cars-stranded-after-heavy-rain-in-south-london> [Accessed August 2024]



Photograph 10: Low point on Nathan Way adjacent to footpath over the Ridgeway

Magpie Lane (Greenwich Reuse and Recycling Centre)

- 2.3.22 Magpie Road is private road which provides access to the Greenwich Reuse and Recycling Centre. A number of gullies and a manhole were identified during the site visit as shown in Photograph 11 and Photograph 12. The gullies are not shown on RBG mapping and the manhole is not mapped on the TWUL data. There appeared to be a low spot in the road and evidence of water previously ponding in the area.



Photograph 11: Entrance to Greenwich Reuse and Recycling Centre



Photograph 12: Entrance to Greenwich Reuse and Recycling Centre

White Hart Road

- 2.3.23 White Hart Road is a residential road owned by RGB. The road is characterised by a steep slope which declines from Plumstead High Street in the south, north towards the railway underpass. The steep and impermeable terrain of the highway allows for the conveyance of surface water to lower elevations to the north.

- 2.3.24 Along the length of White Hart Road are a number of rain gardens, installed by RBG as part of a Sustainable Urban Drainage Scheme and regeneration in the area completed in approximately 2021, shown in Photograph 13. Prior to the installation of the rain gardens, it was understood the combined sewer surcharged on occasions. An assumption was made during the rain garden design that no infiltration would occur due to the land previously being marsh land so the raingardens were lined. Overflow gullies are located within the rain gardens. On inspection, many of these gullies were blocked with debris and soil as shown in Photograph 14, partly due to the large grate size. The inlets and outlets were not visible on some of the gullies. It was also not clear how water was intended to enter the SuDS features, the rain gardens themselves were above road level. There was also evidence of sand and soil on the road surface which has been washed out from the rain gardens, suggesting water was flowing out from the rain gardens onto the impermeable road surface.
- 2.3.25 The lowest elevation on White Hart Road is at the railway underpass. The road then slopes gently upwards towards the north and the Ridgeway. Five rain gardens were installed on this section of White Hart Road and similar issues with blocked gullies were identified here.
- 2.3.26 Video evidence provided by RBG of the flood event on 13th November 2023 shows a surcharging manhole in the highway. This manhole was not mapped on the TWUL dataset provided so its ownership is unknown. Four gullies were identified during the site visit either side of the underpass, which do not appear to be on RGB mapping (only two are present). These were also blocked.
- 2.3.27 It is likely that surface water will flow to the lowest elevation on White Hart Road, the railway underpass. In addition, the rain gardens are not able to function effectively as water is unable to enter the gullies due to blockages and the bed levels of the rain gardens are raised above road level. This increased volume of surface water may result in ponding or exceeded drainage capacity at the lower elevations.



Photograph 13: Rain gardens on White Hart Road



Photograph 14: Debris blocking a gully on White Hart Road.

Flooding Mechanisms

- 2.3.28 Following a review of the data, stakeholder consultation and site walkover it is concluded that the flooding at Nathan Way was a result of the following:
- The steep topography of White Hart Road both to the north and south of the railway line and the impermeable nature of the surface increases the velocity and conveyance of surface water to the lower elevation. This water accumulates in the underpass and to the north of the railway line.

- A review of gullies in the area during the site visit identified the gullies were blocked with debris and the inlets and outlets were not visible, reducing the effectiveness of surface water drainage in this area.
- Site observations and anecdotal evidence indicate surface water and sewer flooding are the predominant drivers for flooding on the 13th November 2023 and 12th December 2023. Video evidence indicates surcharging of drainage assets on White Hart Road on the 13th November. The rainfall event of 13th November was indicated to have an AEP of 74% at Crossness and less than 100% AEP at Danson Park and Deptford rain gauges. This indicates that there is possibly another mechanism influencing the flooding as the drainage capacity would not normally expect to be exceeded during a low event. Anecdotal evidence suggests that Nathan Way, White Hart Road and Magpie Lane all experience flooding when the Crossness Pumping Station (and the combined drainage network leading to it) is at capacity, but has not yet received permission to discharge to the River Thames. This suggests the drainage system backs up and surcharges at the lowest points in the combined drainage network.
- Surface water is assessed to be the predominant flood mechanism, due to the low elevation and impermeable surface area, combined with the combined drainage network backing up due to Crossness Pumping Station not discharging.

Recommendations

2.3.29 Through the assessment of flood mechanisms, several recommendations for improvement have been identified:

- TWUL should investigate upgrading the combined sewer network capacity at White Hart Road and Nathan Way to limit surcharging and ensure that surface water flows can be managed effectively at the lower elevations
- TWUL should investigate whether discharging and failure to discharge from Crossness Pumping Station is causing the drainage network to backup at Nathan Way and White Hart Road
- RBG should undertake a review of the rain gardens on White Hart Road to measure their effectiveness and, if required, put a plan in place to improve
- RBG should ensure routine highway drainage gully cleaning, whilst TWUL should undertake routine monitoring of their sewer networks
- RBG should undertake a CCTV survey of the drainage system in the area to identify the capacity and state of the network, including the surcharging chamber on White Hart Road.

2.4 Plumstead Road

Site Location

- 2.4.1 Plumstead Road (A206) is located in the northeast of the borough approximately 380 m south of the River Thames, at its nearest point, in Plumstead. Plumstead Road runs for approximately 1.25 km from Plumstead High Street in the west to Woolwich Market where the A206 becomes Beresford Street. In the westbound direction, there are three lanes of traffic for most of the road's length, one of which is a bus lane. There is also a separate cycle path. In the eastbound direction, the road varies between two and three lanes, one of which is a bus lane and there is a separate cycle path off the road. The road has a mixture of residential properties, commercial and community buildings such as the Greenwich Islamic Centre adjacent to it.
- 2.4.2 The Wogebourne River lies approximately 1.5 km to the east of Plumstead Road. The remains of the Royal Arsenal Canal, known as Broadwater, are located approximately 400 m north of Plumstead Road which is now a shallow ornamental feature. Crossness Pumping Station is located approximately 4 km's northeast from Plumstead Road, adjacent to the River Thames.
- 2.4.3 Key sites of interest within, and in vicinity to, Plumstead Road are presented in Drawing B8, Appendix B.

Topography

- 2.4.4 LiDAR data shows the land in this area generally slopes downwards towards the River Thames in the north. Plumstead Road slopes gently towards the east from 9.9 m AOD at Woolwich Market to 6.3 m AOD to the north of Plumstead Station. The land then slopes downwards towards the railway line to an elevation of approximately 3.2 m AOD before sloping upwards towards Plumstead High Street. There is a low spot on the road between Villas Road and Lenton Street which lies at approximately 5.8 m AOD.
- 2.4.5 The railway line runs roughly parallel to the south of Plumstead Road and sits within a cutting, lower than the surrounding land. The railway line slopes upwards towards Woolwich Arsenal station from approximately 4.0 m AOD at Plumstead Station to 5.8 m AOD. The land in between Plumstead Road and the railway line generally lies between 7 m AOD and 9.2 m AOD with some high spots directly to the north of Plumstead Station and around Borage Road.
- 2.4.6 The LiDAR data of the site is shown in Drawing B9, Appendix B.

Geology

- 2.4.7 The BGS¹⁷ website identifies the bedrock underlying the site as Thanet Formation of the Thanetian Age. The Thanet Formation is typically composed of homogenous silty fine-grained sand with sandy silt, silt or sandy, silty clay especially in the lower part, forming a coarsening-upwards sequence. The bedrock is overlain by superficial deposits of Alluvium (clay, silt, sand and peat) to the north of the Plumstead Road and an outcrop of Head deposits (clay, silt, sand and gravel) at the site.
- 2.4.8 The Groundwater Aquifer Designation Map¹⁸ indicates the bedrock is a Secondary A Aquifer. The site is on the lower edge of a Secondary (undifferentiated) Aquifer within the Superficial deposits.

Assessing Flood Risk

- 2.4.9 The Environment Agency's Flood Map for Planning¹⁹ shows that the A206 Plumstead Road is predominantly located within Flood Zone 1. The land to the north of the Plumstead Road cycle lane is located within Flood Zones 2 and 3. The land to the east of the site along Plumstead High Street is also located within Flood Zones 2 and 3 with this flood risk extended west along the railway line behind the buildings on Plumstead Road.
- 2.4.10 The Environment Agency's Long Term Flood Risk Map²⁰ shows areas affected by surface water flooding. The mapping shows a low risk flow path along Plumstead Road from Arsenal Way in the west which then is directed northward along Pettman Crescent and into Plumstead Bus Garage. There is an area of surface water High risk (greater than 3.3% AEP) ponding on the footpath and cycle lane in front of 151-152 Plumstead Road. There is also a surface water pathway along the railway line.
- 2.4.11 According to the Environment Agency's Long Term Flood Risk Map, Plumstead Road is not located in an area at residual risk of failure or breach of a reservoir.

Assets

- 2.4.12 It is understood that Plumstead Road is underlain by a combined sewer network, which conveys foul and surface water flows and that there is a combination of RBG gullies and TWUL drainage networks at the site, as shown in Drawing B8, Appendix B.
- 2.4.13 There is a TWUL manhole on the A206 outside 151-152 Plumstead Road, the cover level of which is unknown. There are a number of other manholes behind the properties/businesses to the south of the A206. There are also a number of RBG gullies in the footpath and cycle lane to the south of the A206 and in the cycle lane (Plumstead Road) to the north.
- 2.4.14 The Environment Agency AIMS Spatial Flood Defences (inc. standardised attributes) dataset shows that there are no Environment Agency assets at Plumstead Road. The closest assets are the flood defence walls along the River Thames to the northwest and a culverted channel (Butts Canal) to the southeast.

Hydrology

- 2.4.15 See Section 0 for details of the hydrology and rainfall events local to the site.

Flood History

- 2.4.16 Information provided by RGB LLFA and Street Services Team indicate that flooding occurred on the cycle lane and in the bus stop outside 151-152 Plumstead Road on the 28th April 2024 and 6th May 2024. During the 28th April event, RGB Street Services Team attended the event and pumped out the water. Photograph 15 shows the extent of the flooding when they arrived on the scene at roughly 7:15am.
- 2.4.17 Video evidence shown during the site visit by 151-152 Plumstead Road showed the whole of the westbound lanes of Plumstead Road, including the cycle lane and footpath, underwater at 6:20am on 28th April 2024 and reported water came into the store 3-4 inches deep.
- 2.4.18 Anecdotal evidence indicated two basement flats flooded although the date of this is unknown.
- 2.4.19 This flood history may not be exhaustive and is collected from the information available from RGB and during the site visit.



Photograph 15: Flooding to the cycle lane outside

Site Observations

Plumstead Road

- 2.4.20 Plumstead Road is an A road owned by RGB. The road falls in elevation from Woolwich Station in the west towards Plumstead Station, although the surface water flow path mapped on the Environment Agency's Long Term Flood Risk Map²⁰ shows the flow path heading north at Pettman Crescent before the row of shops where flooding was reported. The slope and impermeable terrain of the highway allows for the conveyance of surface water to lower elevations in the east.
- 2.4.21 The roadside gullies along the length of 151-152 have large inlet openings without gratings, as shown in Photograph 19. RGB Street Services Team confirmed that large debris such as bottles have been found in the drainage system during jetting which could have been causing blockages in the drainage network.
- 2.4.22 It is understood that Plumstead Road is underlain by a combined sewer network and that there is a combination of RGB gullies and TWUL drainage networks at the site (Photograph 16 and Photograph 17). Anecdotal evidence from the Street Services Team reports that there is a large 3 m TWUL pipe which is located to the left of the supermarket (roughly in the location of the shutter in Photograph 18). There is a mapped TWUL manhole towards the rear of the supermarket, as shown in Drawing B8, Appendix B, however the mapping show this is connected to the drainage system by a 150 millimetre

(mm) diameter pipe. The Street Services Team reported they have jetted and tested the drains during dry weather and no issues have been reported. They commented water appears to back up from the sewer during times of severe weather and also highlighted the Crossness Pumping Station was discharging at the time so the flooding may have been related to overflow.

- 2.4.23 It is likely that high volumes of surface water will be directed to the lowest elevation on Plumstead Road. When the local surface water drainage is blocked, ponding and possibly flooding to the local properties is likely to occur.



Photograph 16: Road gullies with wide openings which are known to become blocked at location of flooding



Photograph 17: Cycle lane and bus lane outside 151-152 Plumstead Road



Photograph 18: TWUL drainage assets believed to run between buildings behind the shutters

Flooding Mechanisms

- 2.4.24 Following a review of the data, stakeholder consultation and site walkover it is concluded that the flooding at Plumstead Road was a result of the following:

- The low elevation of the section of Plumstead Road outside of the supermarket and the impermeable nature of the surface allows water to pond and the sloping gradient of the land from the west increases the velocity and conveyance of surface water to the lower elevation
- A review of roadside gullies in the area during the site visit identified the gullies had large inlets, without gratings, which could allow large debris to enter the drainage network and cause blockages, reducing the effectiveness of drainage
- Site observations and anecdotal evidence indicate surface water is the predominant driver for flooding on the 28th April 2024 and 6th May 2024. The rainfall event had an AEP of 74% and <100% respectively, indicating the rainfall event was a relatively regular event. This indicates that there is possibly another mechanism influencing the flooding as the drainage capacity would not normally expect to be exceeded during a low event. Anecdotal evidence suggests that Plumstead Road experiences flooding when the Crossness Pumping Station is discharging as the drainage system is overwhelmed which causes it to backup.

Recommendations

- 2.4.25 Through the assessment of flood mechanisms, several recommendations for improvement have been identified:

- RBG should replace the road gullies with gullies with gratings to prevent large debris from entering the system
- TWUL should investigate whether discharging and failure to discharge from Crossness Pumping Station is causing the drainage network to backup at Plumstead Road

- RBG should ensure routine highway drainage gully cleaning, whilst TWUL should undertake routine monitoring of sewer network
- RBG should undertake a CCTV survey of the drainage system in the area to identify the capacity and state of the network.

2.5 Plumstead High Street

Site Location

- 2.5.1 Plumstead High Street (A206) is located in the northeast of the borough approximately 1 km south east of the River Thames in Plumstead, as shown in Drawings B1 and B2, Appendix B. Plumstead High Street runs for approximately 1.5 km from Plumstead Station in the west to Woodhurst Road where the A206 becomes Bostall Hill. The road is a single carriageway with one lane of traffic in each direction. The road has a mixture of residential properties and commercial properties adjacent to it.
- 2.5.2 The Wogebourne River is culverted under the A206 near Woodhurst Road where Plumstead High Street becomes Bostall Hill. The lower reaches of the watercourse in Plumstead, Abbey Wood, and Thamesmead are mostly culverted beneath residential areas.
- 2.5.3 Key sites of interest within, and in vicinity to, Plumstead Road are presented in Drawing B10, Appendix B.

Topography

- 2.5.4 LiDAR data shows the land in this area generally slopes downwards towards Abbey Wood and the River Thames in the north. Plumstead High Street slopes gently upwards towards the south east from 4.1 m AOD at the most northern point of Plumstead High Street to 11.45 m AOD at Woodhurst Road. There is a low spot on the road to the south east of Plumstead Station outside S & M Garage and Motor Services where the elevation is approximately 3.8 m AOD.
- 2.5.5 The LiDAR data of the site is shown in Drawing B11, Appendix B.

Geology

- 2.5.6 The BGS¹⁷ website identifies the bedrock underlying the site as Thanet Formation of the Thanetian Age. The Thanet Formation is typically composed of homogenous silty fine-grained sand with sandy silt, silt or sandy, silty clay especially in the lower part, forming a coarsening-upwards sequence. The bedrock is overlain by superficial deposits of Alluvium (clay, silt, sand and peat) to the north of the railway line and an outcrop of Head deposits (clay, silt, sand and gravel) at the site.
- 2.5.7 The Groundwater Aquifer Designation Map¹⁸ indicates the bedrock is a Secondary A Aquifer. The site is on the lower edge of a Secondary (undifferentiated) Aquifer within the Superficial deposits.

Assessing Flood Risk

- 2.5.8 The Environment Agency's Flood Map for Planning¹⁹ shows that the section of Plumstead High Street between Heverham Road and Griffin Road is located within Flood Zone 3. This area of flood risk extends to the east and to the north. The land to the south of Plumstead High Street is predominately located within Flood Zone 1.
- 2.5.9 The Environment Agency's Long Term Flood Risk Map²⁰ shows areas affected by surface water flooding. The mapping shows a flow path onto Plumstead High Street from the south with water flowing down Griffin Road and Ancona Road and a flow path from the east along the highway. The flow path appears to flow northwards into and through S & M Garage and Motor Services before flowing eastwards along the railway line and Reidhaven Road towards White Hart Road. A large area of this flow path is classed as High risk (greater than 3.3% AEP) including the highway outside 11 – 15 Plumstead Street (S & M Garage and Motor Services) and the area to the north.
- 2.5.10 In accordance with the Environment Agency's Long Term Flood Risk Map, Plumstead High Street is not located in an area at residual risk of failure or breach of a reservoir.

Assets

- 2.5.11 It is understood that Plumstead High Street is underlain by a combined sewer network, which conveys foul and surface water flows and that there are a combination of RBG and TWUL gullies and drainage networks at the site, as shown in Drawing B10, Appendix B.
- 2.5.12 There are three TWUL manholes within the carpark of 11 – 15 Plumstead Street and further manholes to the north outside the workshop, cover levels are unknown. There are three TWUL manholes behind the properties to the west of the garage. To the south the highway, there is a TWUL manhole on the A206 Plumstead Road outside the convenience store with a cover level of 4.64 m AOD. To the east of Orchard Road there are 5 TWUL manholes, the one on Orchard Road has a cover level of 4.68 m AOD and the manhole outside the beauty salon has a cover level of 3.96 m AOD. There are also a number of RBG gullies on Plumstead High Street.
- 2.5.13 The Environment Agency AIMS Spatial Flood Defences (inc. standardised attributes) dataset shows that there are no Environment Agency assets at Plumstead Road. The closest assets are the flood defence walls along the River Thames to the northwest and a culverted channel (Butts Canal) to the southeast.

Hydrology

- 2.5.14 See Section 0 for details of the hydrology and rainfall events local to the site.

Flood History

- 2.5.15 Anecdotal evidence provided by the owner of 11 – 15 Plumstead High Street indicates that two to three flood events had occurred in the last two years on Plumstead High Street. The flooding has affected the highway outside of the garage and has caused internal flooding into the workshop. No precise dates were provided.

Site Observations

Plumstead High Street

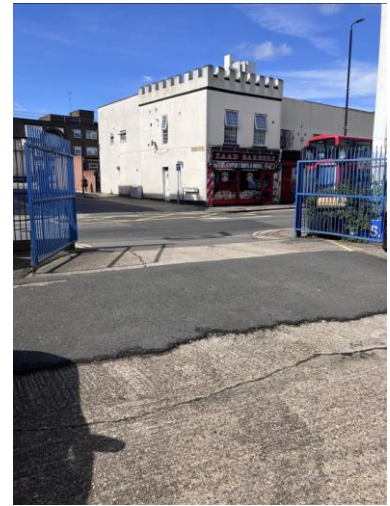
- 2.5.16 Plumstead High Street is an A class road owned by RGB. The road generally inclines towards the south east and the Environment Agency's Long Term Flood Risk Map²⁰ shows the flow paths from the south and the south east converge on the highway outside of the S & M Garage and Motor Services. The slope and impermeable terrain of the highway allows for the conveyance of surface water to these lower elevations.
- 2.5.17 A low spot was visible during the site visit on the highway directly outside the garage and two gullies are located in the road as shown in Photograph 21.
- 2.5.18 RBG Street Services Team confirmed that highway contractors identified a faulty swan neck outlet in one of the roadside gullies outside 22 Plumstead High Street. Work was undertaken in early 2024 (exact date unknown) to remove the swan neck outlet and re connect the gully to the network. An additional roadside gully was also added 10 m from the problem gully. No information was provided by RGB as to the gully cleaning regime in the area.
- 2.5.19 The land inside the garage unit slopes steeply downwards, as shown in Photograph 19 which allows conveyance of surface water from the road into the garage. In an effort to prevent this, a raised tarmac bund has been added in the entrance to the garage by the owner as a means to stop the flow path.
- 2.5.20 Anecdotal evidence from the garage suggested that no flooding has occurred since the work was carried out to replace the swan neck in the gully.
- 2.5.21 It is likely that high volumes of surface water are directed to the low point outside of the garage. Prior to the replacement of the swan neck outlet, the gullies did not provide adequate drainage into the surface water network, causing it to flow over the tarmac bund and into the garage premises.



Photograph 19: Entrance to S&M Garage and Motor Services featuring tarmac bund inside entrance.



Photograph 20: location to remove swan neck outlet and add additional road gully.



Photograph 21: View from within S&M Garage and Motor Services towards low point in the highway.

Flooding Mechanisms

2.5.22 Following a review of the data, stakeholder consultation and site walkover it is concluded that the flooding at Plumstead High Street was a result of the following:

- Steep topography of the land to the south (from Griffin Road and Ancona Road) and from the south east (from Plumstead High Street) increases the velocity and conveyance of surface water towards the area outside of the garage. Surface water accumulates in the low point. Previously, this water was unable to drain away due to an issue with the swan neck outlet in the drainage system which would cause the water to backup, flood the highway and eventually overflow the bund into the garage
- The maintenance schedule and condition of the remaining gullies at the site is unknown. This could have an impact on the flood mechanisms
- The predominant flood mechanism is assessed to be an issue with the swan neck inlet in the gully on the opposite side of the road to the garage. The topography of the area and the impermeable surface cause surface water to accumulate in the low point outside the garage which was previously unable to drain away due the previously mentioned issues.

Recommendations

2.5.23 Through the assessment of flood mechanisms, several recommendations for improvement have been identified:

- RBG should ensure routine highway drainage gully cleaning, whilst TWUL should undertake routine monitoring of sewer network
- RBG should undertake a CCTV survey of the drainage system in the area to identify the capacity state of the network.

3. Conclusions and Recommendations (Next Steps)

3.1 Summary

- 3.1.1 This Section 19 investigation for RBG was triggered as a result of flooding experienced across the borough from November 2023 to May 2024
- 3.1.2 A total of four sites across RBG where reports of flooding were highly concentrated were identified for review within this investigation in order to assess the specific flood mechanisms and sources that resulted in flooding to these locations.
- 3.1.3 This investigation identifies that RBG is primarily at risk of sewer flooding and surface water flooding. Various topographical factors exacerbate flood risk at certain locations throughout the borough, encouraging floodwaters to flow towards and collect within local low spots which often have inadequate drainage infrastructure. A further source of flooding to Nathan Way, Plumstead Road and Plumstead High Street is believed to be due to activities at Crossness Pumping Station which can cause surcharging of the combined TWUL sewer, predominantly impacting lower lying areas of highway. The investigation identified that no internal flooding was experienced at the sites featured on the dates identified.

3.2 Recommendations

- 3.2.1 Through the assessment of flood mechanisms and impacts of flood events described in this report, several recommendations for improvement have been identified. These site-specific recommendations are summarised below. A number of general recommendations have also been made.

Site-Specific Recommendations

- 3.2.2 Within each section of this report, recommendations have been provided in order to help reduce the future risk of flooding at the four sites investigated. This is especially important when considering that climate change is expected to increase the frequency and intensity of extreme rainfall events, which will likely raise both the severity of flooding and the number of flood events experienced across RBG. These recommendations are summarised below in Table 3-1.

Table 3-1: Site Specific Recommendations

Location	Recommendation	Owner
	RBG should ensure routine highway drainage gully cleaning is undertaken	RBG
	TWUL should undertake routine monitoring of their sewer networks; and	TWUL
Kingsground	RBG should investigate a solution for reducing surface water runoff across the paddock and ensuring surface water is able to enter the drainage network on King John's Walk. Possible solutions include constructing a kerb along the edge of the King John's Walk to direct flow into the surface water drainage network and prevent flow passing onto the paddock.	RBG
	TWUL should investigate upgrading the combined sewer network capacity at White Hart Road and Nathan Way to limit surcharging and ensure that surface water flows can be managed effectively at the low spots;	TWUL
Nathan Way / White Hart Road	TWUL should investigate whether discharging and failure to discharge from Crossness Pumping Station is causing the drainage network to backup at Nathan Way and White Hart Road;	TWUL
	RBG should undertake a review of the rain gardens on White Hart Road to measure their effectiveness and, if required, put a plan in place to improve.	RBG

Location	Recommendation	Owner
	RBG should ensure routine highway drainage gully cleaning is undertaken	RBG
	TWUL should undertake routine monitoring of their sewer networks; and	TWUL
	RBG should undertake a CCTV survey of the drainage system in the area to identify the capacity and state of the network, including the surcharging chamber on White Hart Road	RBG
	RBG should replace the road gullies with gullies with gratings to prevent large debris from entering the system;	RBG
Plumstead Road	TWUL should investigate whether discharging and failure to discharge from Crossness Pumping Station is causing the drainage network to backup at Plumstead Road;	TWUL
	RBG should ensure routine highway drainage gully cleaning, whilst TWUL should undertake routine monitoring of sewer networks; and	RBG / TWUL
	RBG should undertake a CCTV survey of the drainage system in the area to identify the capacity and state of the network.	RBG
	RBG should ensure routine highway drainage gully cleaning is undertaken	RBG
Plumstead High Street	TWUL should undertake routine monitoring of their sewer networks; and	TWUL
	RBG should undertake a CCTV survey of the drainage system in the area to identify the capacity and state of the network.	RBG

General Recommendations

- 3.2.3 As LLFA, RBG are responsible for the coordination of flood risk management strategies and actions, within the administrative boundary. It is suggested that the recommendations listed within this Section 19 report are incorporated into an Action Plan, to be produced by the relevant RMAs. This Action Plan should be monitored and discussed at future operational flood group meetings. Following a review of this Section 19 Report and liaison with RMAs, should flood risk be considered unacceptable at a site, RBG should investigate potential capital schemes which could provide flood alleviation.
- 3.2.4 Recommendations have been categorised as statutory or non-statutory. Statutory recommendations are a legal requirement and must be implemented as part of the Section 19 Flood Investigation. It is important to identify the statutory recommendations, to ensure appropriate action is taken. Non-statutory recommendations are not required under law yet are considered to be of benefit to the management of flood risk within the area.
- 3.2.5 The strategic recommendations require the involvement of several stakeholder groups and can be adopted across the Royal Borough of Greenwich.

Table 3-2: General Recommendations

Recommendation	Owner	Statutory or Non-Statutory
RBG is to publish the findings of the Section 19 Flood Investigation Report. The published report will aid the development of flood mitigation strategies and provide vital information for RMAs.	RBG	Statutory
An Action Plan should be created by RBG, which aims to outline timescales and milestones for delivery of recommendations presented within this report.	RBG	Non-Statutory
TWUL should review the capacity of the sewer system in areas affected by the flooding, to ascertain whether there is any scope to invest and prioritise construction at these locations.	TWUL	Non-Statutory
TWUL should consider conducting a review of road drainage infrastructure within the sites at Nathan Way, Plumstead Road and Plumstead High Street. If sewer capacity cannot be increased, changes to the road design may reduce risk of water ingress and property damage; potential changes could include raised kerb heights and permeable paving.	TWUL	Non-Statutory

Recommendation	Owner	Statutory or Non-Statutory
Revision of the gully clearance regime is recommended, to ensure the maintenance and clearance is frequent enough to prevent build-up of leaves and debris. It is recommended that the importance of clear gullies and drains is communicated to residents, to increase awareness and promote local action. If residents take an active role in monitoring and reporting the gully condition, this could improve the effectiveness of drainage within the area.	RBG and Local Residents	Non-Statutory
RBG have commissioned consultants to undertake studies of high-risk areas and of the sewer and gully capacities. Findings from the study will contribute to the understanding of what measures could be implemented, such as additional gullies, SuDS or other alternatives which may help to alleviate flood risk RBG should discuss the findings with relevant stakeholder groups and seek to implement, as appropriate	RBG	Non-Statutory

Appendix A British Standard BS 85600:2017 Section 4

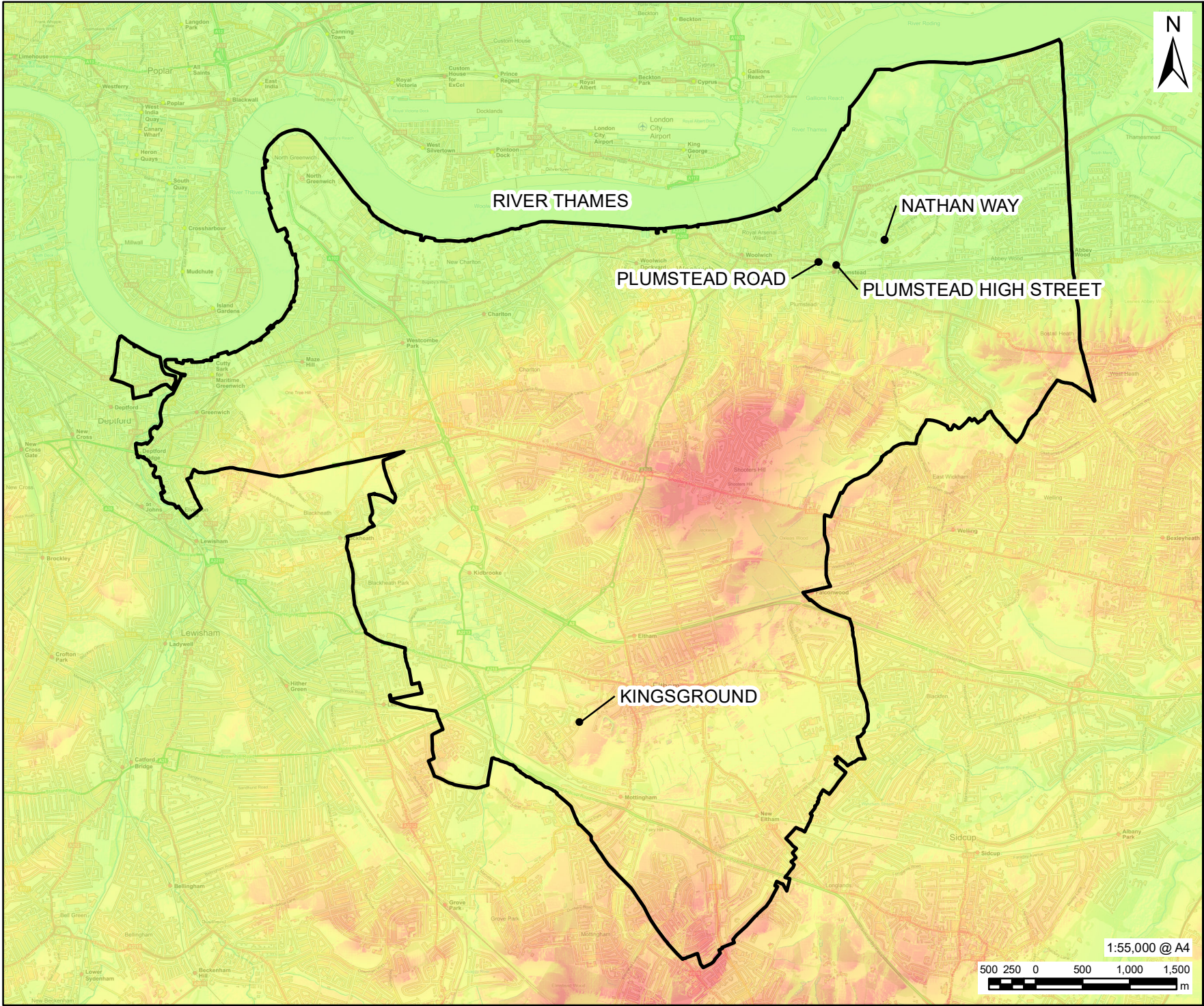
A.1 British Standard BS 85600:2017 Section 4

The following are guideline thresholds for determining the need for an investigation, but can vary depending on whether the area(s) affected is rural or urban and whether there is any ambiguity as to the source of the flooding:

1. Flooding of significant infrastructure (hospital, school, utilities, treatment works, etc.);
2. Flooding of a key transport link, e.g. primary routes (A-roads and motorways), key rail links;
3. Internal flooding of one or more premises on more than one occasion in the past five years (excluding gardens and detached garages/out-buildings, but including integral garages); and
4. Internal flooding of five or more properties in close proximity during a single incident.

If any of the criteria are met then a flood investigation should be commenced, taking account of the severity and extent of flooding (to inform timescales and resources). If the criteria are not met, then this fact and the decision not to investigate should be recorded. The recorded incidents should determine the initial scope and methodology for the survey(s) (one incident might involve several different surveys), and the decision as to whether the survey will involve a desk study and/or a site visit. This should involve identifying the means of capturing the data and in what format they should be recorded and stored to ensure the information can be viewed and shared for use by any relevant parties in the future.

Appendix B Drawings



AECOM

PROJECT

Section 19 Flood
Investigation Report

CLIENT

Royal Borough of
Greenwich

CONSULTANT

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Midpoint, Alencon Link
Basingstoke, Hampshire
RG21 7PP
www.aecom.com

LEGEND

LIDAR

Value

High : 130.395
Low : -22.418

Greenwich
Boundary

NOTES

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2. To be read in conjunction with Section 19 Flood Investigation Report, AECOM 2024

ISSUE PURPOSE

DRAFT FOR COMMENT

PROJECT NUMBER

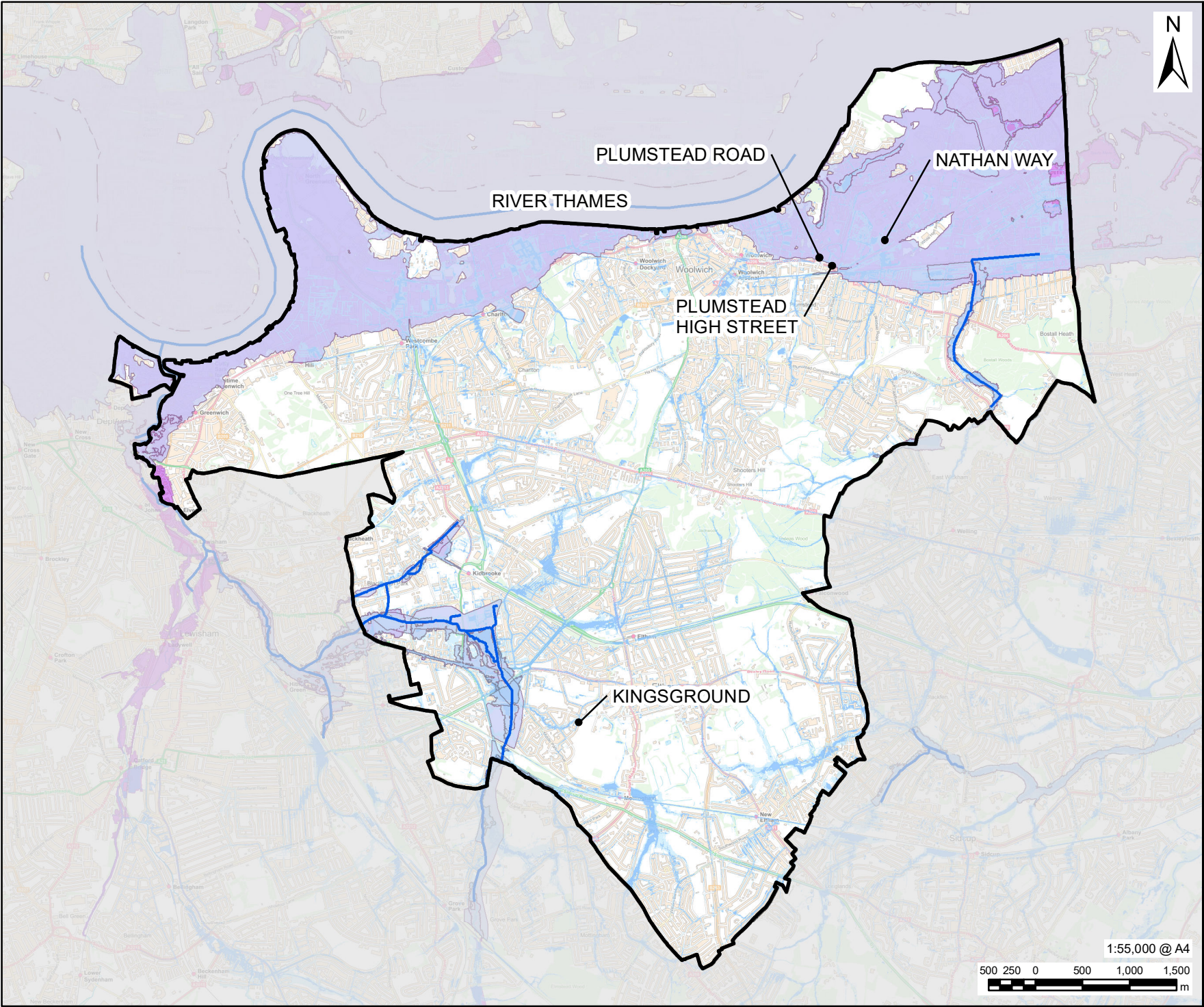
60731992

FIGURE TITLE

LONDON BOROUGH OF
GREENWICH SITE LOCATION
PLAN AND LIDAR

FIGURE NUMBER

DRAWING B1



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Section 19 Flood
Investigation Report

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LEGEND

- Greenwich Boundary
- Main River
- SW
- Medium
- Low
- Flood Map for Planning**
- Flood Zone 2
- Flood Zone 3

NOTES

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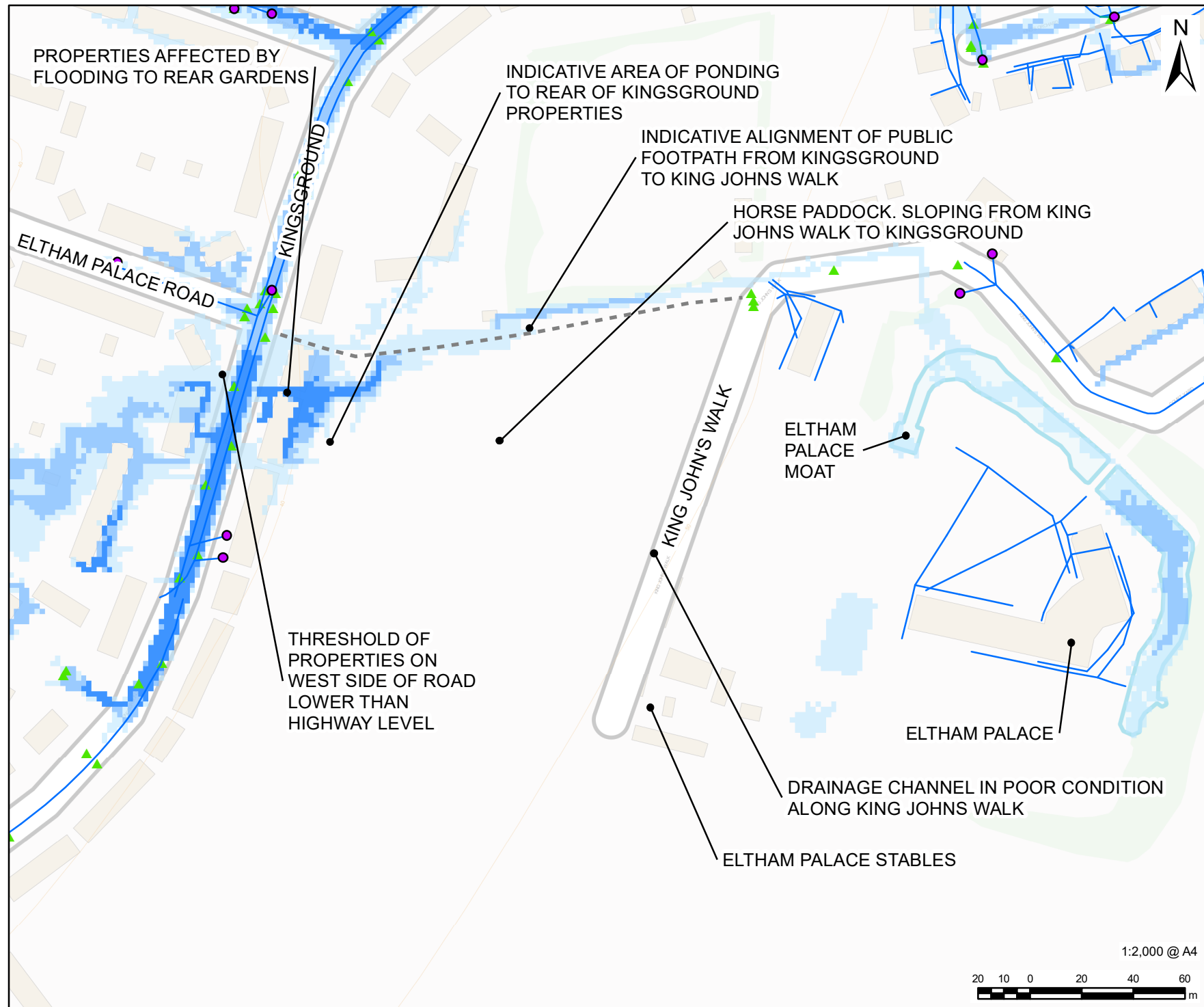
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FIGURE TITLE

LONDON BOROUGH OF
GREENWICH FLOOD RISK
OVERVIEW

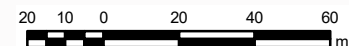
FIGURE NUMBER

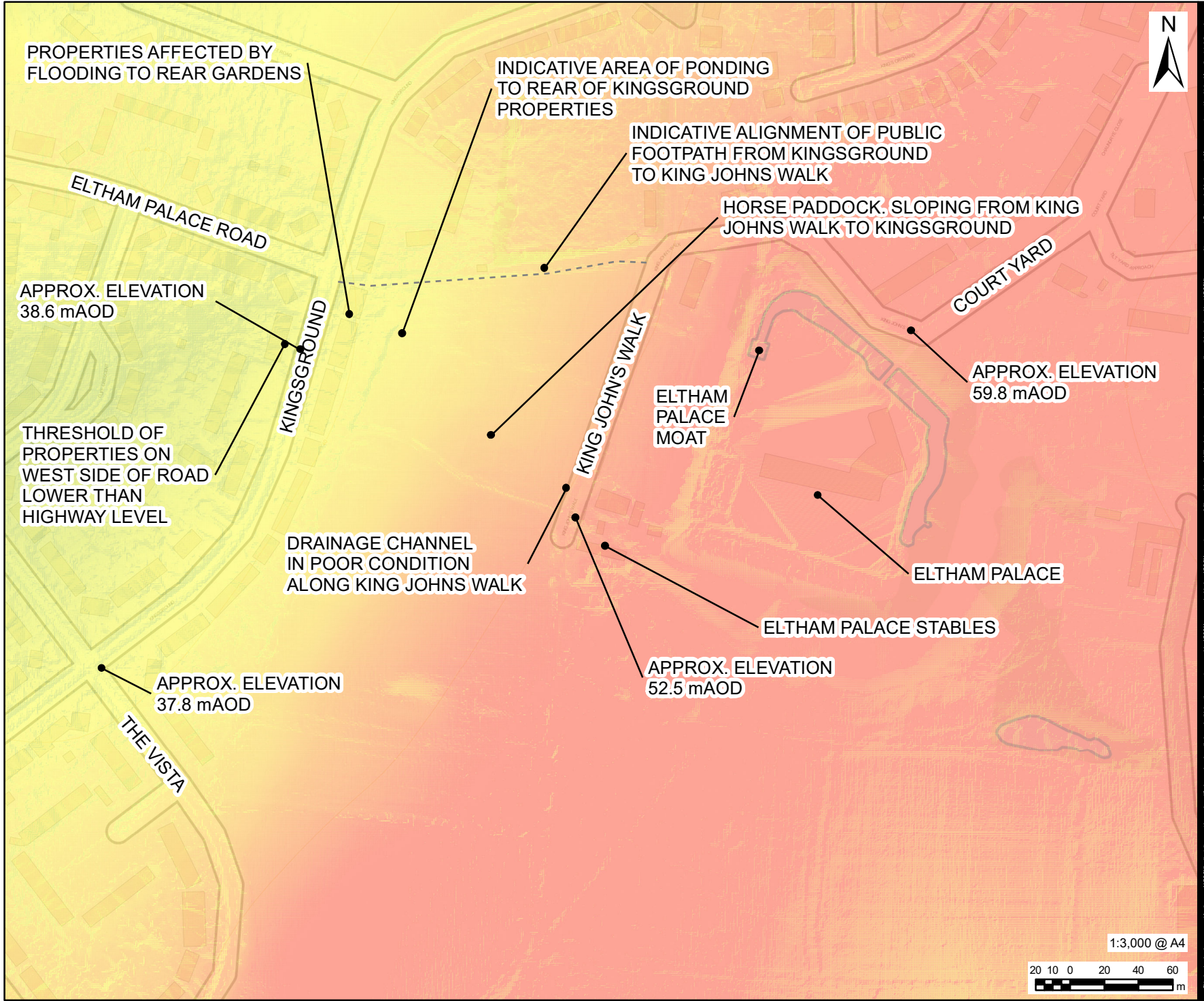
DRAWING B2



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Section 19 Flood
Investigation Report

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LEGEND

LIDAR

67.77 mAOD
22.37 mAOD

NOTES

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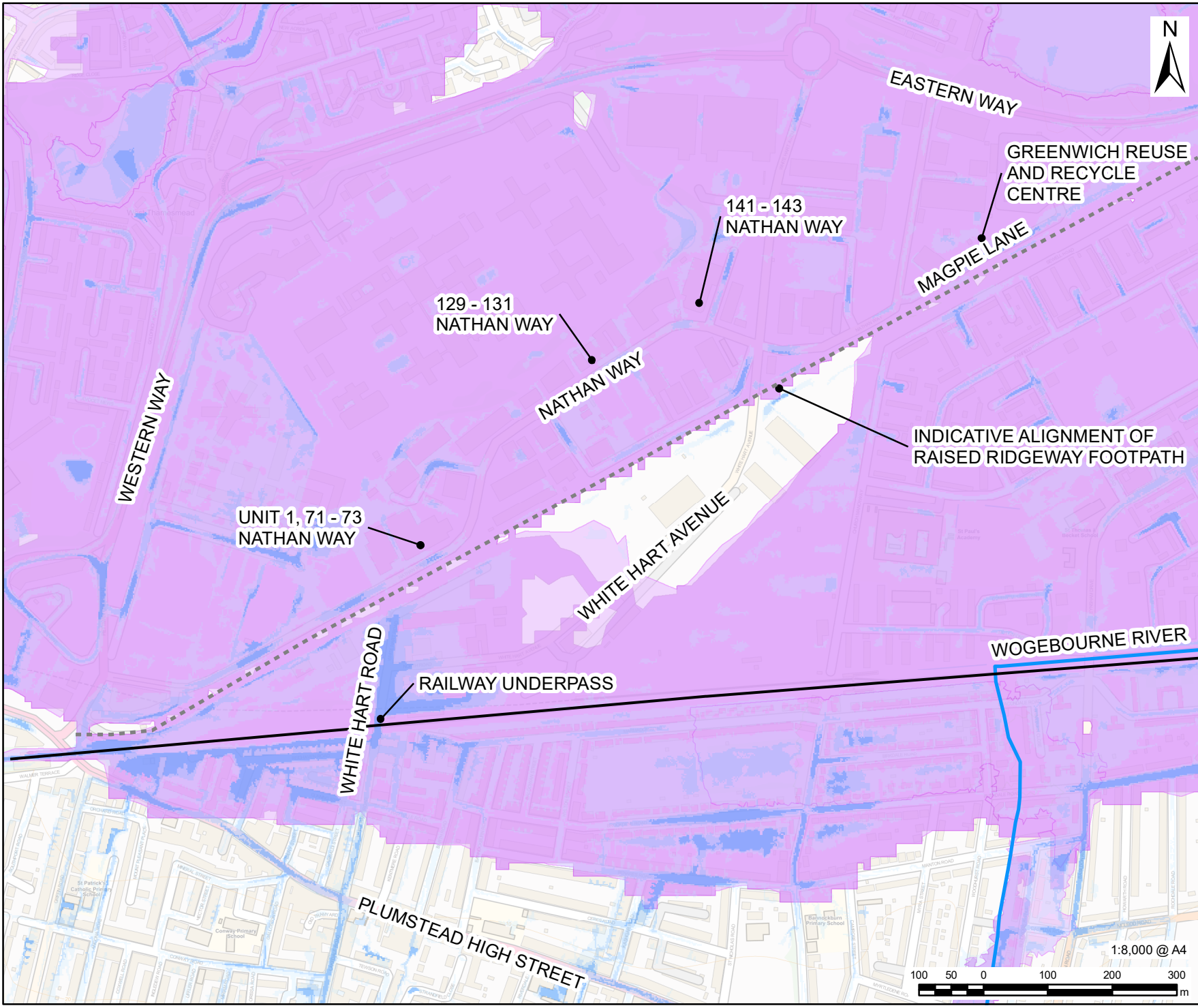
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FIGURE TITLE

KINGSGROUND LIDAR

FIGURE NUMBER

DRAWING B4



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Section 19 Flood
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LEGEND

Main River

Flood Map for
Planning

Flood Zone 2

Flood Zone 3

Risk of Flooding
from Surface Water

High

Medium

Low

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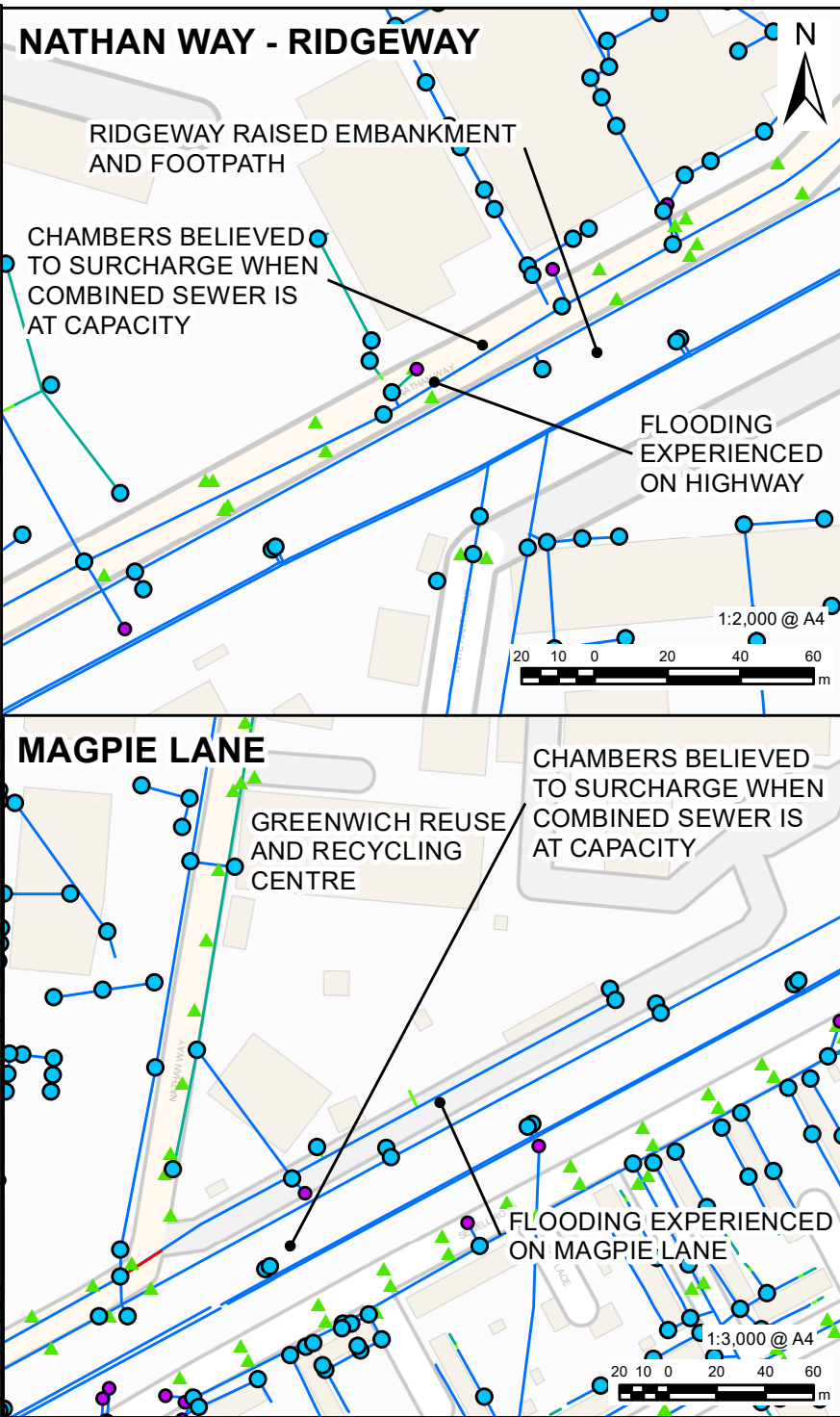
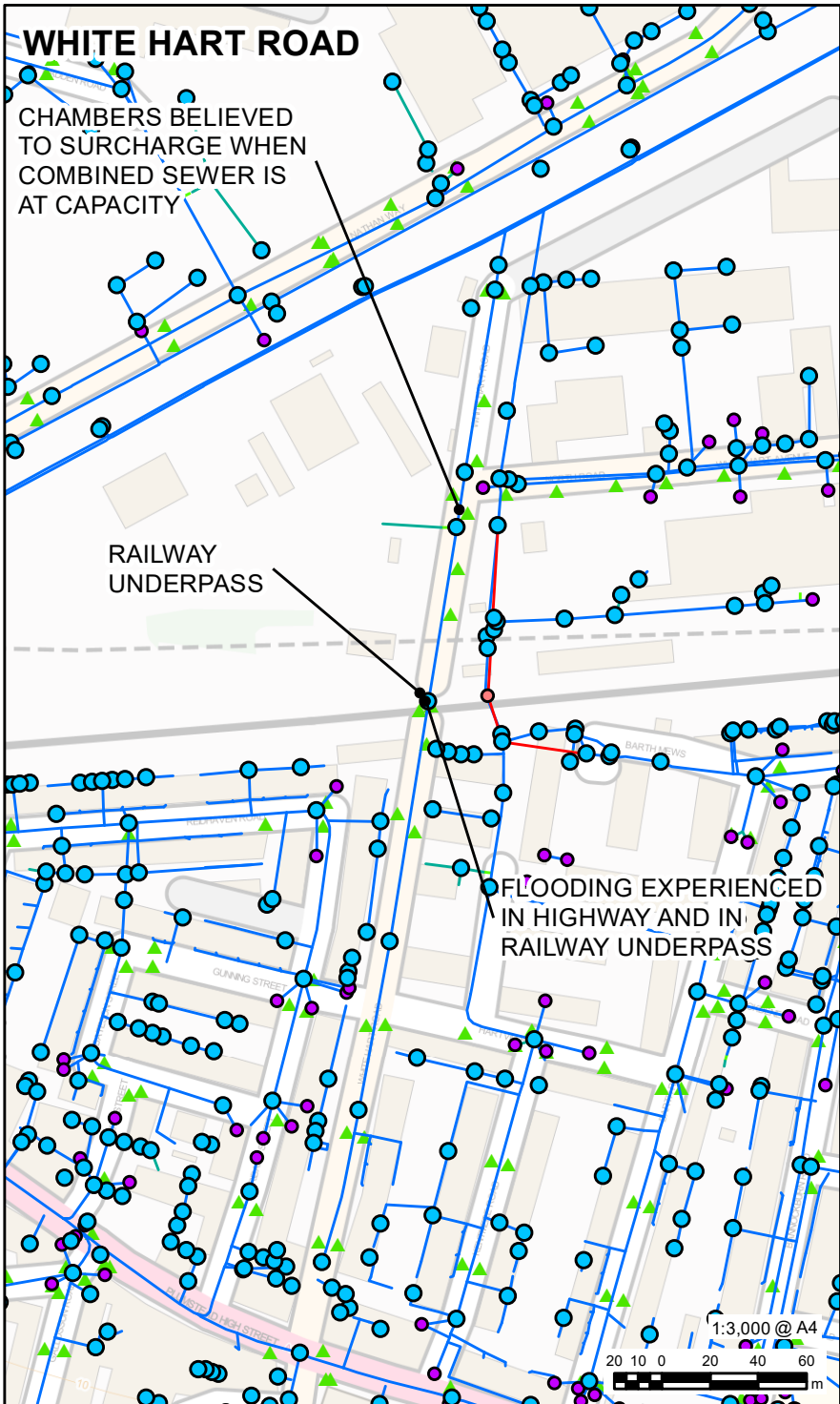
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FIGURE TITLE

NATHAN WAY FLOOD RISK

FIGURE NUMBER

DRAWING B5



PROJECT

Section 19 Flood Investigation Report

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LEGEND

- TWUL Waste Water Manhole
- TWUL Abandoned Manhole
- TWUL End Sewer Item
- TWUL Waste Water Abandoned Sewer
- TWUL Drain
- TWUL Gravity Sewer
- TWUL Lateral
- ▲ RBG Road Gullies

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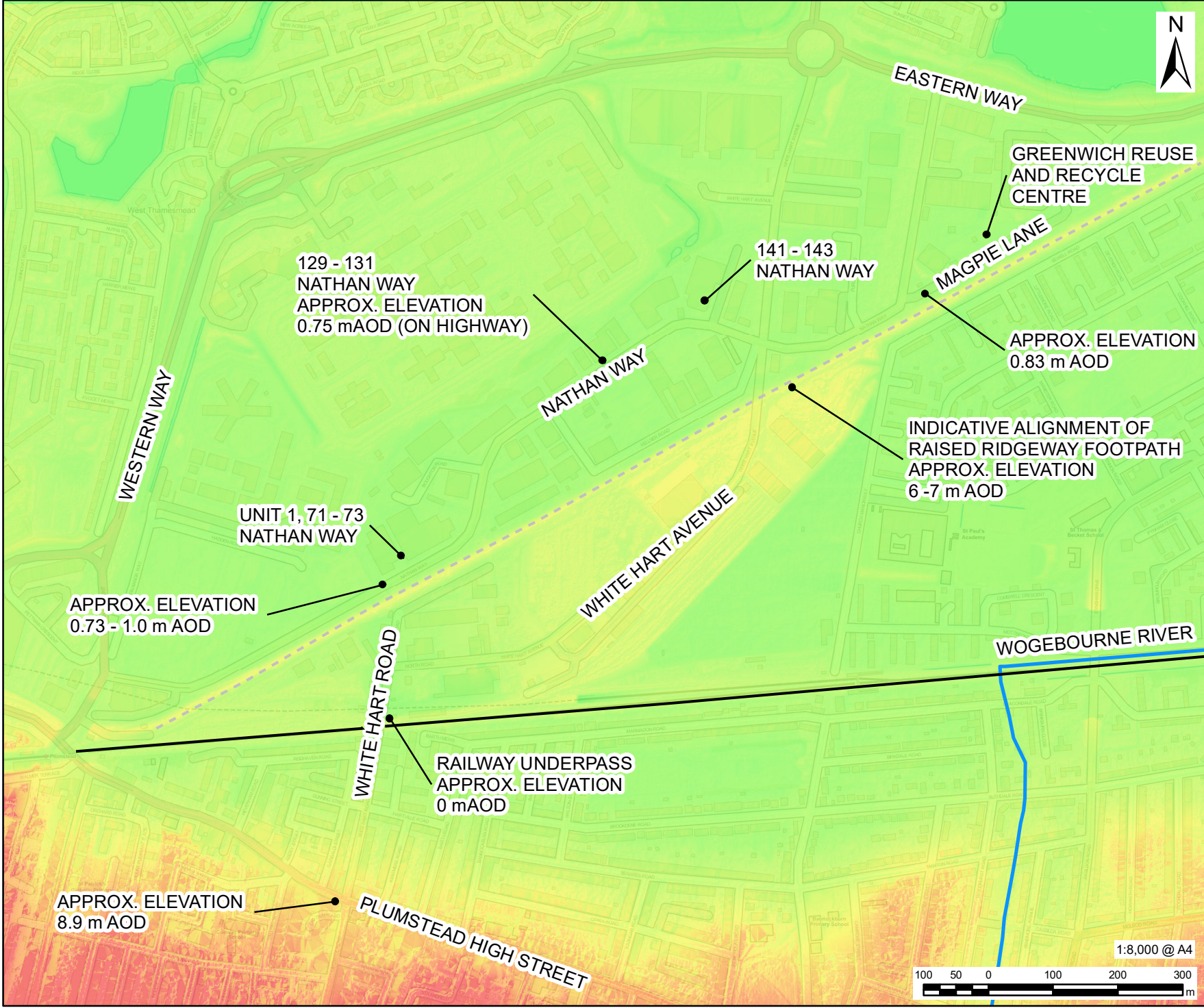
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FIGURE TITLE

NATHAN WAY - DRAINAGE ASSETS

FIGURE NUMBER

DRAWING B6



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PROJECT

Section 19 Flood
Investigation Report

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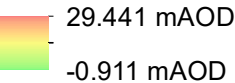
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LEGEND

LIDAR



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PROJECT NUMBER

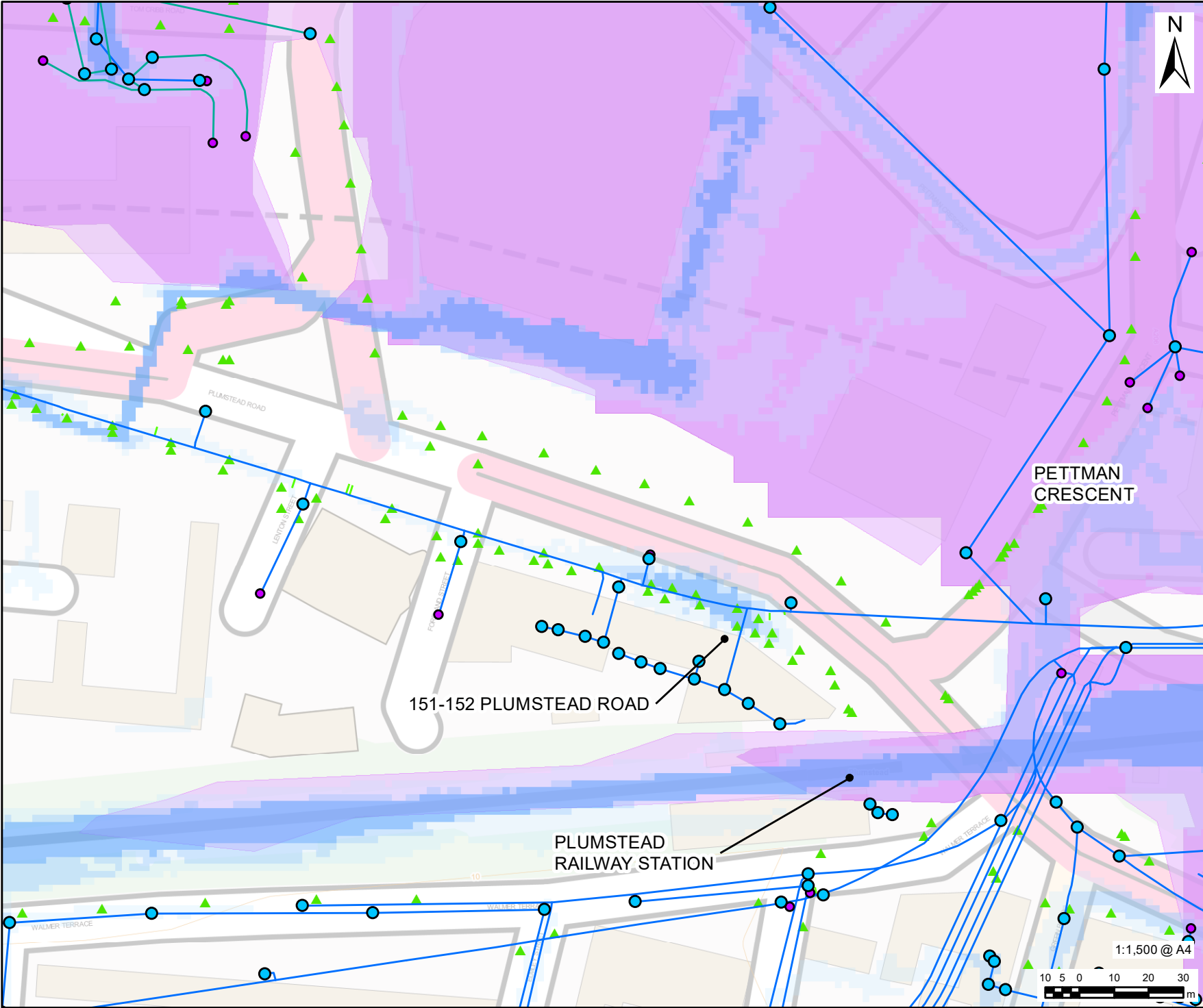
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FIGURE TITLE

NATHAN WAY - LIDAR

FIGURE NUMBER

DRAWING B7



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PROJECT

Flood Investigation
Report

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LEGEND

- TWUL Waste Water Manhole
- TWUL End Sewer Item
- TWUL Drain
- TWUL Gravity Sewer
- TWUL Lateral
- RBG Road Gullies

Risk of Flooding from Surface Water

- High
- Medium
- Low

Flood Map for Planning

- Flood Zone 2
- Flood Zone 3

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ISSUE PURPOSE

DRAFT FOR COMMENT

PROJECT NUMBER

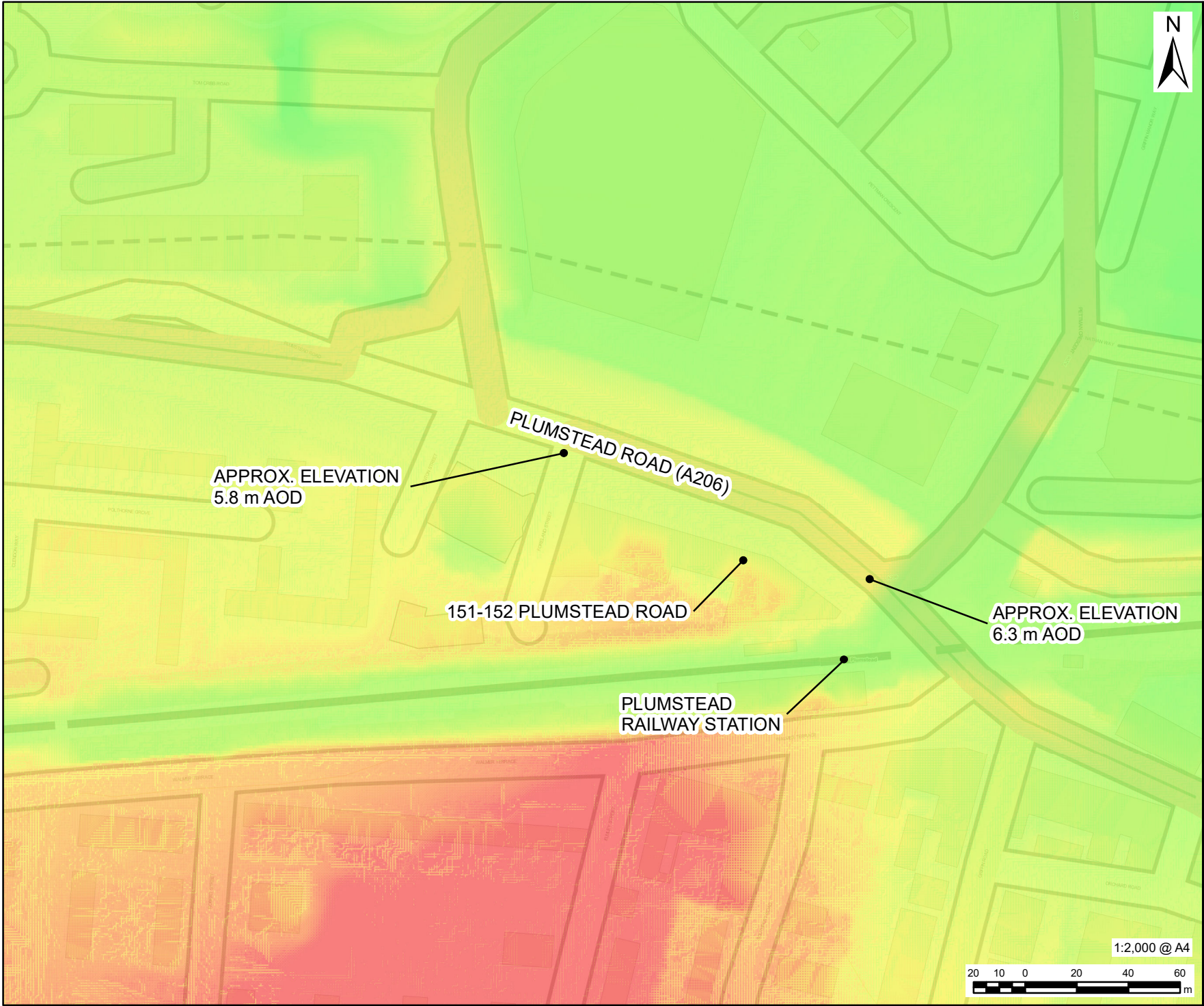
60731992

FIGURE TITLE

PLUMSTEAD ROAD - DRAINAGE
ASSETS AND FLOOD RISK

FIGURE NUMBER

DRAWING B8



PROJECT

Section 19 Flood
Investigation Report

CLIENT

Royal Borough of
Greenwich

CONSULTANT

AECOM Limited
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www.aecom.com

LEGEND

LIDAR

21.882 mAOD
0 mAOD

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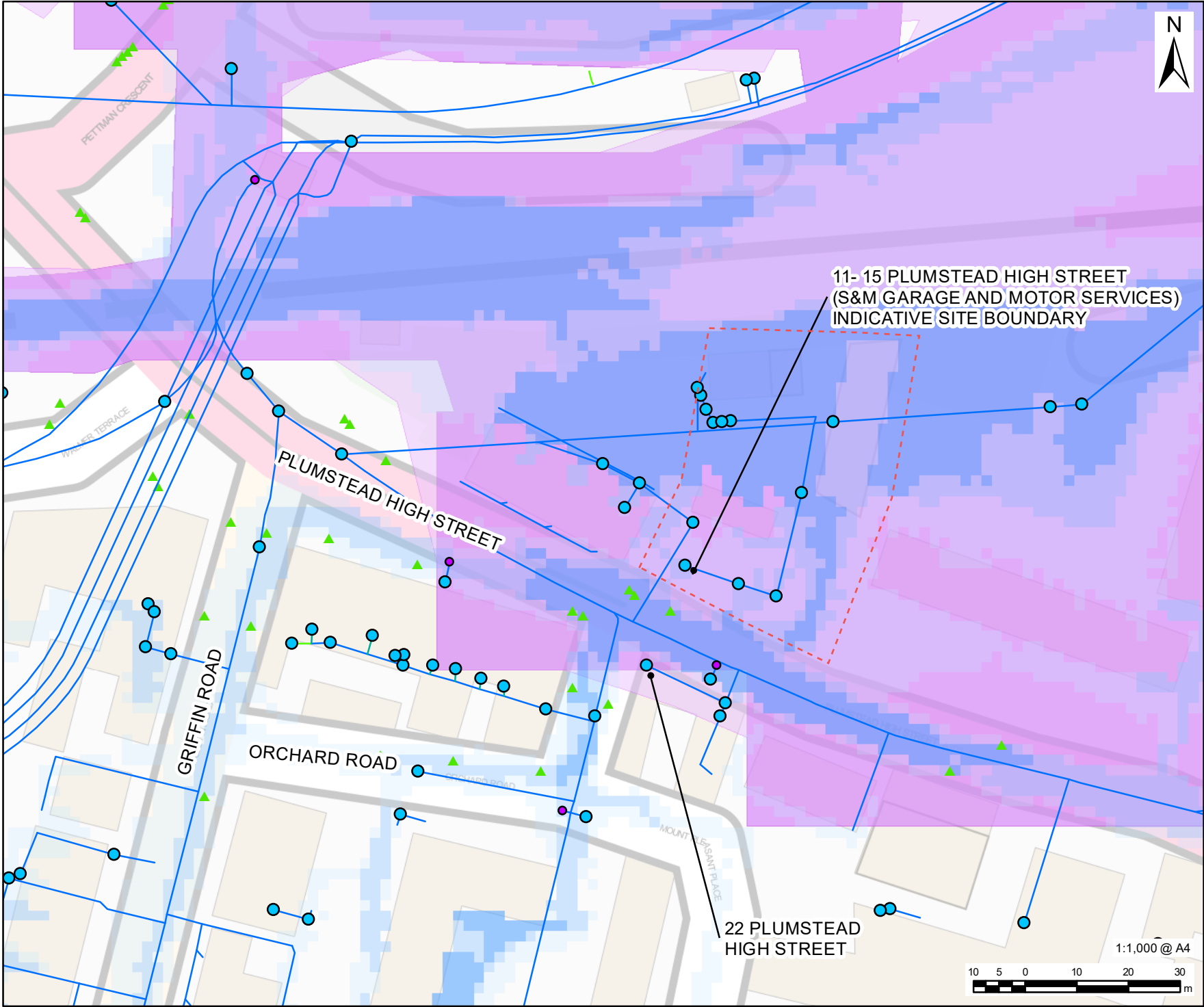
60731992

FIGURE TITLE

PLUMSTEAD ROAD - LIDAR

FIGURE NUMBER

DRAWING B9



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www.aecom.com

LEGEND

- TWUL Waste Water Manhole
- TWUL End Sewer Item
- TWUL Drain
- TWUL Gravity Sewer
- TWUL Lateral
- RBG Road Gullies

**Risk of Flooding from
Surface Water**

- High
- Medium
- Low

Flood Map for Planning

- Flood Zone 2
- Flood Zone 3

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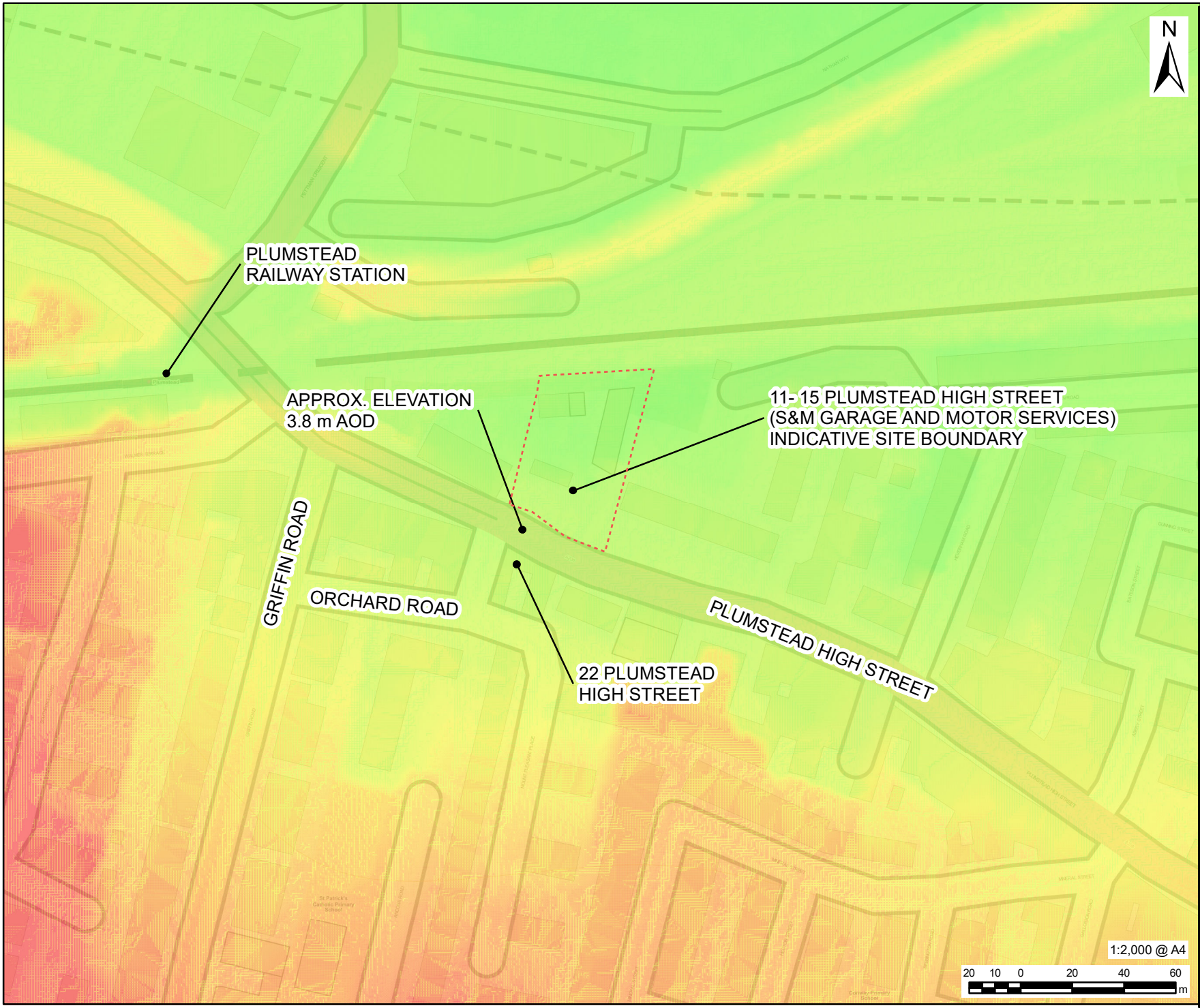
60731992

FIGURE TITLE

PLUMSTEAD HIGH STREET -
DRAINAGE ASSETS AND FLOOD
RISK

FIGURE NUMBER

DRAWING B10



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PROJECT

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LEGEND

LIDAR

22.35 mAOD
-0.116 mAOD

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FIGURE TITLE

PLUMSTEAD HIGH STREET -
LIDAR

FIGURE NUMBER

DRAWING B11

